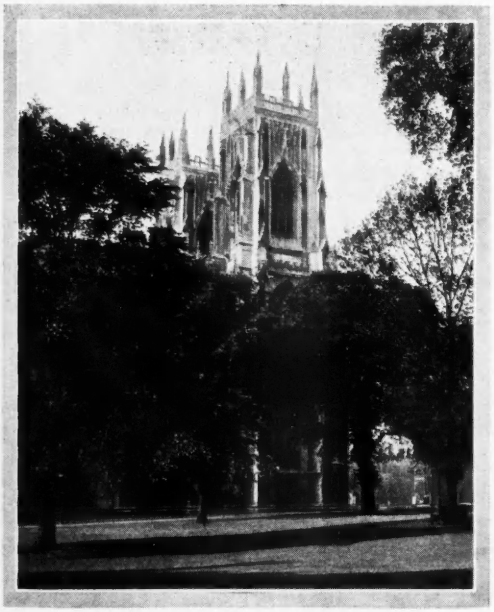
DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XIII. No. 153. SEPTEMBER, 1932. PRICE 1s. NET



YORK MINSTER FROM THE DEAN'S PARK.
The British Association Meets this year at York.
(See pages 275-280.)

CONTENTS.

INDEX TO ADVERTISEMENTS.

British Association Number, September, 1932.

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. XIII. No. 153. SEPTEMBER, 1932. PRICE 1s. NET

Publishers: Benn Brothers, Ltd. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4. (Closed on Saturday.)

Telephone City 0244. Telegrams: Benbrolish, Fleet, London.

Annual Subscriptions 12s. 6d. post free anywhere in the world. Single numbers 1s. net; single back numbers more than two years old, 1s. 6d. net; postage (inland and foreign) 2d.

Binding cases, price 2s. 6d. net each; postage 6d.

Notes of the Month.

In this special number devoted to the British Association, Sir Alfred Ewing looks back on the outstanding discoveries announced at its meetings since the "Friends of Science" first met at York in 1831. In looking back, the President also looks to the future, and points a warning against the dangers of progress in applied science. We are reminded, he says, of man's ignorance in putting new inventions only to rational use by the problems of unemployment, in so far as it results from the mechanization of industry, by the homicidal conditions of the road, and even by the revival of banditry. It is interesting to look back on the position of science in this country a hundred years ago, and to trace the change in the attitude of the public to science no less than the change in the approach of the scientists to their problems. As the horizon of scientific discovery has receded, the specialists themselves have tended to become less dogmatic and more tolerant of opposite opinion, for experience has shown that the hypotheses of to-day may be reversed to-morrow.

[*Elliott & Fry.*

THE ARCHBISHOP OF YORK
whose message to *Discovery* appears on another page.

* * * * *

We take particular pleasure in the message from the Archbishop of York which appears on page 279, for Dr. Temple was intimately associated with the launching of *Discovery* and has followed its progress with interest. On page 284 we publish a "Who's Who" of those who are to read the presidential addresses in the sectional meetings.

* * * * *

The Marchese Marconi's successful experiments in the use of ultra-short waves is a remarkable advance in the development of wireless. The discovery appropriately comes on the eve of the Radio Exhibition in London, and shows that communications may be made over distances hitherto thought impracticable owing to the curvature of the earth. The experiments were carried out over a distance of 170 miles, using an apparatus of low power fitted with portable reflectors. In earlier experiments it had only been possible to traverse a distance within the normal horizon, and instead of the heavy and cumbersome apparatus, a light portable set has now been devised for this purpose. The experiments open up interesting possibilities for the future of ultra-short waves, and further tests will be keenly watched in this country.

* * *

The first results of the excavations at Verulamium, the Romano-British city near St. Albans, were described in *Discovery* by Dr. Mortimer Wheeler two years ago. The author then forecast great possibilities for further work on the site. The third season's work started last month and has

already been rewarded by the discovery of a large mosaic Roman pavement adjoining the site of the "Neptune" pavement uncovered last year. It measures 33 feet by 20 feet, and contains sixteen panels each of individual design. An elaborate central heating system is indicated in a new series of rooms just excavated. The walls of the rooms bear intricate decorations, and the discovery of coins in a fall of plaster will assist the excavators in arriving at the date at which the house was abandoned. Dr. Wheeler reports that the plaster itself is exceedingly interesting. There was first a moulding of patterned green, then a violet skirting, then again a green band, surmounted by a striking arrangement of flowers, leaves and ears of corn. Members of the party are now engaged in piecing the wall together. An attempt is also being made at Verulamium to discover the Western Gate. Meanwhile Miss Kathleen Kenyon, a daughter of Sir Frederic Kenyon, is superintending the investigations of the first century Roman settlement.

* * * * *

The pacification of Papua was discussed by Sir Hubert Murray, the governor of the island, in his inaugural speech as president of the Australian Society for the Advancement of Science. He spoke of the change in methods of native administration, and said that they were not trying to make the brown man white but to make him a better brown man than before. It is a striking tribute to modern administration that so unpromising material as head hunters and cannibals have been brought within normal humanitarian rule in Papua. Subjugation of native races is happily becoming a thing of the past, and the new school of administrators has come to realize that the common humanity of black and white is the only means of adjusting racial differences.

* * * * *

Professor Piccard's new balloon ascent to a height of ten and a half miles has been given wide publicity in the newspapers. The spectacular aspect of the flight has somewhat obscured its scientific significance. Last year the Professor ascended nearly ten miles with the object of measuring the cosmic rays at a height at which thay had not been absorbed by the atmosphere. Human life is, of course, impossible at such a height, and the ascent was made in an airtight "laboratory." In his latest attempt, the Professor remained up for as long as twelve hours, and new observations of the stratosphere were made. We do not yet know what part the penetrating power of cosmic radiation may play in such every-day processes as the formation of cloud. If Professor Piccard's observations provide a solution they will be of great value to meteorology. It is possible that the electrification of the clouds is induced in some way by the radiation. There are many other problems connected with the stratosphere which are likely to be solved by observations at high altitudes.

* * * * *

The Egypt Exploration Society, founded in 1882 as the Egypt Exploration Fund, celebrates its fiftieth anniversary this month. On another page Miss M. A. Chubb contributes an account of the latest excavations at Tell el Amarna. To mark the jubilee the society is holding a special meeting at which short papers by Professor F. Griffith, Professor P. E. Newberry, and Dr. A. S. Hunt summarizing its fifty years' work will be read. An exhibition has been arranged by the Trustees of the British Museum of Egyptian antiquities presented by the Society to the Museum almost annually since the first excavations in 1892-3. In the Egyptian sculpture gallery a selection of the most valuable gifts of this kind will be exhibited. The most important contribution to the Museum, however, is the splendid series of stone monuments in the sculpture gallery itself. These are all labelled for the occasion, so that it will be possible for the public to gain some idea of the value of this collection. A short guide to the exhibition will contain a summary of the various excavations undertaken by the Society and of the objects recovered from them for the National Collection. Smaller exhibitions have also been arranged at which will be on view the Greek papyri presented to the department of manuscripts, and the vases and fayence from Naucratis and Daphnae, given to the Greek and Roman department.

* * * * *

Incidentally, at the recent Congress of Prehistoric Sciences in London attention was again called to the attitude of the Egyptian Government towards archaeological investigation in Egypt. Its rights to preserve and arrange its own antiquities will, of course, be respected; but the matter is of far more than national concern. It is, indeed, of vital interest wherever the history of man's culture is a serious study. A resolution was passed at the Congress requesting the Egyptian Government to ensure that prehistoric finds should remain accessible for study, and to prevent the dispersion of collections. In more ways than one the official attitude has been disastrous to the study of early Egyptian history. It has also been the direct cause of financial loss to the Egyptian people by diverting funds which would have been available for fellahin labour. The resolution of the Congress calls attention to a very serious situation in archaeological studies.

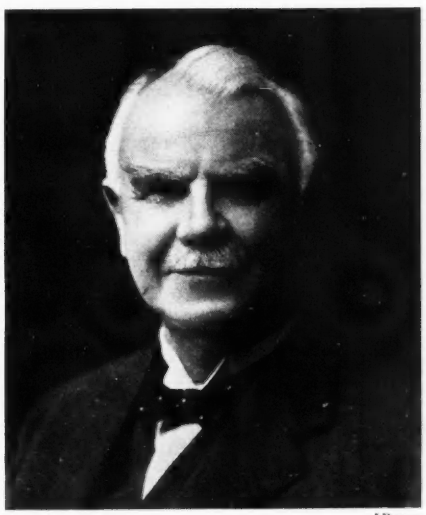
The British Association: Looking Back.

By Sir Alfred Ewing, K.C.B., F.R.S.

President of the British Association, 1932.

As in previous years we are privileged to publish in our British Association number a foreword specially contributed by the President. In the following article Sir Alfred Ewing looks back on some of the outstanding discoveries which have marked the progress of science since the first meeting of the Association at York.

AFTER the excitement and publicity of its Centenary celebrations last year in London, the British Association comes quietly back to its birthplace in a sober mood appropriate to the times. It begins the second century of its existence conscious of an established position and a demonstrated usefulness. It has long ago shed whatever was ephemeral. The sciences which it was created to advance have in fact advanced to an extent that exceeds all expectations. Their advance continues and accelerates. More than ever they require the sort of interpretation to the world which the Association is fitted to give. Public interest in them is vastly wider and keener than it was a hundred years ago.



[*Bacon.*

SIR ALFRED EWING.

With the accumulation of facts and theories every science grows harder for the layman to understand. The experts tend to become segregated into camps with as many separate dialects. The dialect of each is a progressive private slang, taking forms that are less and less intelligible to the others and more remote from the language of the ordinary man. Nevertheless the ordinary man wishes to keep track of new scientific ideas knowing that they are pretty certain, in the long run, to affect his habits of life, if not his habits of thought.

The Association had its origin in the early days of the industrial revolution. What made that revolution possible was the application of mechanical power, following on the inventions of James Watt. Steam provided a new and potent means of supplementing the power of men and animals. Later came the internal combustion engine, a competitor whose strength was apparent when for fuel it turned from coal-gas to oil. It triumphed on the roads and in the air, serving uses there that steam could not have effectively served. But the turbine of Parsons re-established the supremacy of steam as the most economical means of manufacturing power on a large scale. With electricity as its distributing agent it still dominates the situation except where small mobile power-stations are required, as in motor-cars and aircraft.

Another development of applied science which the Association has witnessed from its beginning is the art of electrical communication. The telegraph of Cooke and Wheatstone had its birth during our early years; it was followed by a long and successful struggle to link up nations and hemispheres by means of the submarine cable. In 1876 Sir William Thomson, who played a great part in that struggle, told Section A of a visit to the United States from which he had just returned, bringing with him a wonderful novelty, a specimen of the earliest telephone of Graham Bell. The fact that he could not make it work, at least in the hearing of the audience, added a touch of mystery to the interest of his communication. A year or so later came the first phonograph of Edison, which recorded speech by indenting a sheet of tinfoil stretched over grooves in a drum turned by hand. The modern gramophone is its offspring, and certainly that very perfect instrument cannot lament, with Elijah, that it is not better than its fathers. I recall a never to be forgotten experience when the tinfoil gave back one's own authentic voice with all its natural imperfections embarrassingly emphasized.

At the Oxford meeting in 1894 the late Lord Rayleigh opened a fresh chapter when he announced the discovery of Argon. To my mind, that discovery definitely marks the beginning of the new physics. It was soon followed by Radioactivity, the X-Rays,

and the Electron. Just before the century closed came Planck's first paper on the Quantum, which has had a more profound influence on scientific thought than even the doctrine of Relativity. Literary people sometimes talk of the 'nineties as "decadent." In matters of science they were exceptionally fertile and inspiring. The discoveries of the 'nineties led on to those conceptions of atomic structure, atomic energy and quanta of radiation which have partially lifted the curtain on a strange world and opened vistas for further research. We may, I hope, hear at York something of the latest results.

As to political and economic and social effects, we are increasingly aware that progress in applied science has its drawbacks and its dangers. Disarmament conferences, the problems of unemployment arising from the mechanization of industry, the homicidal condition of the roads, even the revival of banditry and other acts of violence under the cover of quick escape—these are things that remind us how far man is from knowing how to put his many inventions only to beneficent and rational and unselfish use.

The Future of Science from an Engineer's Outlook.

In his presidential address to the British Association on August 31st, Sir Alfred Ewing will view the future of scientific discovery from an engineer's point of view. According to a forecast of the address authorized by the British Association, the President will discuss the change in the attitude of the scientists from one of "cocksureness" to a frank admission that they are groping in a half-light, "tentatively grasping what at best are only half truths." He will point out that the new spirit strengthens a sense of brotherhood between the specialist and the layman, while the advance of science makes an increasing claim on the layman's notice through its technical applications.

Thus the British Association keeps its hold on the public because it links experts with one another and with the laymen, to the benefit of all.

The President will recall the lack of scientific knowledge on the part of early British engineers, and will point to the need in those days for the "scientific leaven" which the British Association provided in this branch of science. At the date of the foundation of the Association more than fifty years had passed since the invention of Watt provided an engine fit to serve as a general means of providing power. But neither the engineers nor the physicists of that period had any notion that the process involved the conversion of heat into mechanical work.

Turning to electricity, Sir Alfred will describe the "whole art of electrical communication" as an unqualified blessing, "which even the folly of nations cannot pervert." He will point out that before it came into use the sections of civilized man were far more separate than they will ever be again. He will ask whether it is possible to imagine any practical gift of science more indispensable as a step towards establishing the sense of international brotherhood which we now consciously lack and wistfully desire.

The President will suggest a changed spirit in the present-day thinkers' attitude towards mechanical progress. Admiration is tempered by criticism; complacency has given way to doubt; doubt is passing into alarm. He will suggest that there is a sense of perplexity and frustration, as in one who has gone a long way and finds he has taken the wrong turning. To go back is impossible. How, Sir Alfred will ask, is he to proceed? Where will he find himself if he follows this path or that? The President will describe himself as "an old exponent of applied mechanics" as he expresses something of the delusion with which, now standing aside, he watches the sweeping pageant of discovery and invention in which he used to take unbounded delight. It is impossible, he will say, not to ask, whither does this tremendous procession tend? What, after all, is its goal? What its probable influence upon the future of the human race?

He will describe the "pageant" itself as a modern affair. A century ago it had barely taken form and had acquired none of the momentum which rather awes us to-day. What Sir Alfred will describe as "the cornucopia of the engineer" has been shaken over all the earth, scattering everywhere an endowment of previously unpossessed and unimagined capacities and powers. The President will admit that beyond question many of these gifts are benefits to man, making life fuller, wider, healthier and richer in comfort and interest. But he will point to the danger that the engineer's gifts may be grievously abused. The command of nature has been put into man's hands before he knows how to command himself.

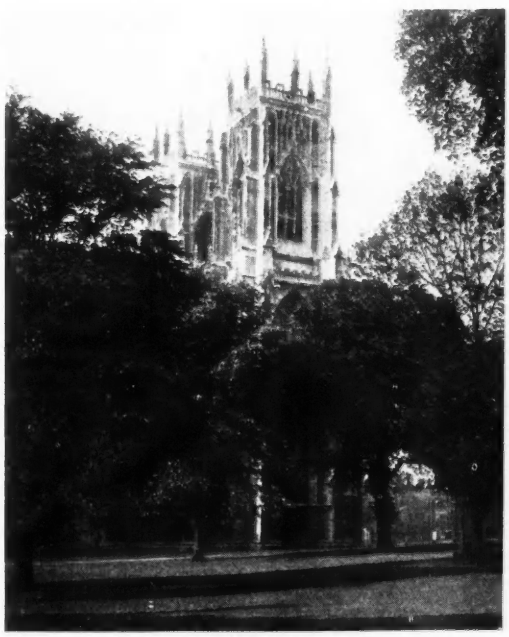
The President will conclude by discussing the effect of mechanical production on human effort. He will suggest that there is a sinister side even to the peaceful activities of those who in good faith make it their business to adapt the resources of nature to the use and convenience of man.

The British Association at York.

The British Association for the Advancement of Science was founded at York in 1831 *and again visited the city for its jubilee meeting in* 1881. *After the impressive centenary celebrations in London last year, it is fitting that the Association should return to its birthplace as it embarks on its second century.*

THE British Association appropriately returns to York for the opening of its second century, for it was at York that the first meeting of the "Friends of Science" was held in September, 1831. As Mr. O. J. R. Howarth recalls in his book, "The British Association: A Retrospect," the mother society of the Association was the Yorkshire Philosophical Society, for the council of that flourishing body issued the first circular about the proposed meeting to other societies and to individual "cultivators and promoters of science." A committee of management was formed in York with the Rev. William Harcourt as chairman and Professor John Phillips as secretary.

Describing the first meeting, Dr. James Johnston wrote: "It was a preparatory meeting, but so showy and glittering that a stranger might have thought men had here met together to turn philosophy into sport rather than to cultivate science in earnest. But it was only the first proof, of which we afterwards received many, of the kindly feelings and hospitality of the people of York, which had induced them on this occasion to assemble—ladies and gentlemen with equal zeal—to do honour to science." It was Phillips, very appropriately, who gave the first scientific address to the Association at this informal meeting. Harcourt then formally proposed the foundation of "a British Association for the Advancement of Science, having for its objects to give a stronger impulse and more systematic direction to scientific inquiry, to obtain a greater degree of national attention to objects of science, and a removal of those disadvantages which impede its progress, and to promote the intercourse of the cultivators of science with one another, and with foreign philosophers."



YORK MINSTER.
A view from the corner of the Dean's Park.

Harcourt's speech provides an interesting sidelight on the position of science in this country at that time. "Some difference of opinion may exist," he said, "as to the want in which we stand of a new association to give a stronger impulse and a more systematic direction to scientific inquiry. I do not rest my opinion of this want upon any complaint of the decline of science in England. It would be a strange anomaly if the science of the nation were declining while the general intelligence and prosperity increase. There is good reason indeed to regret that it does not make more rapid progress in so favourable a soil, and that its cultivation is not proportionate to the advantages which this country affords, and the immunity from vulgar cares which a mature state of social refinement implies. But in no other than this relative sense can I admit science to have declined in England."

What three names, he asked, if they excepted the name of Newton, could be shown in any one age who ranked higher than those of Davy, Wollaston and Young, three great scientists who had just then died. But it was not by counting the great luminaries who might chance to shine in this year or that—in a decade of years or a generation of men—that they were to inform themselves of the state of national science. Let them look rather to the numbers engaged, effectually though less conspicuously, in adding by degrees to their knowledge of nature; let them look to the increase of scientific transactions and journals; let them look at the list produced that day of philosophical societies which had grown up in all parts of the kingdom. The multiplication of those new and numerous institutions, the

President declared, indicated a wide extension of scientific pursuits; the funds so liberally contributed to their support bore evidence of an enlarged disposition in the public to promote such pursuits.

Harcourt concluded a fine and stirring speech with these words: "The council of the Yorkshire Philosophical Society have not the presumption to dictate to this meeting the course which it may be for the interests of philosophy to pursue. They collected in the first instance the best opinions which they could obtain, before they proceeded to mature their plan. They now wait for the opinion of the eminent persons who are here assembled before they can assure themselves that it is as feasible in practice as it appears in theory." That it was indeed "as feasible in practice as it appeared in theory," the years have shown.

THE FIRST MEMBERSHIP TICKET.

One of the tickets issued to members at the first meeting of the British Association. Reproduced from "The British Association: A Retrospect," by O. J. R. Howarth.

The British Association met again at York in 1844. This meeting was notable for the paper delivered to the Geological Section by the Very Rev. William Cockburn, Dean of York. Dr. Cockburn was obsessed with the belief that the statements of Holy Scripture about the creation of the earth were being controverted by the doctrines of geology, particularly as enunciated by Professor W. Buckland in "The Bridgewater Treatise." In 1838 he had published "A Letter to Professor Buckland Concerning the Origin of the World," and "A Remonstrance upon the Dangers of Peripatetic Philosophy" (an *alias* for the British Association), which he addressed to the President. Mr. Howarth recalls in his book that Cockburn's paper, entitled "Critical Remarks on Certain Passages in Dr. Buckland's Bridgewater Treatise," opened with an endeavour to demolish Buckland's theories about the formation of the earth, and then proceeded to develop those of the author himself.

"I suppose," said the Dean, "that everything in the world was made at one time; nothing has been added, nothing taken away. The world was as now, land and water, both resting on a strong basis consisting of granite rocks. So the world continued for nearly two thousand years—the land, the air and water being all thickly peopled. Then there burst forth, by natural or supernatural means, numerous submarine volcanoes. The first broke through the crust of granite stones, and threw up (but not to the top of the water) a great quantity of these pulverized and perhaps melted stones mixed with clay, which, slowly subsiding in the tranquil sea, produced the strata of the transition series."

The Flood was then invoked as a further supernatural agent, and "the embedded fossils represent the remains of the animals that were alive when the convulsions began, and were so obliging as to die in the definite and regular order in which their shells and bones are now deposited." The latter quotation is from "The Life and Letters of Sedgwick," and is not, it need hardly be added, an extract from Dr. Cockburn's paper! The Rev. Adam Sedgwick had been put up to oppose the Dean of York, and, as Mr. Howarth remarks, did so to the alternate amusement and exaltation of the audience! His castigation, however, did not silence Dr. Cockburn for the future, and his paper, published under the title "The Bible Defended Against the British Association," ran through five editions in a year.

The British Association returned to its birthplace for the jubilee meeting of 1881. The President was Sir John Lubbock (later Lord Avebury), who during his lifetime filled the varied offices of President of the Institute of Bankers, Vice-Chancellor of London University, President of the London Chamber of Commerce and chairman of the London County Council. It is interesting to note that at an evening discourse at the jubilee meeting, a novelty was introduced in the use of electric incandescent lamps. The meeting of 1881 was also notable for the fact that a past-president was found to take the chair of every section except that of Economics, over which Sir Grant Duff, Governor of Madras, presided. Before the engineering section, J. Emerson Dowson exhibited

his plant for producing gas for motive power in the factory, and the first demonstration was given of its use in driving an Otto gas engine.

It was at the time of the jubilee meeting that the British Association met with considerable criticism. The critics asserted alternatively that the Association was not doing its work, or that it had already done its work. The criticism was renewed three years later when the first meeting overseas was held; and at Manchester in 1887 Alfred Newton evidently had opposition to meet, for he spoke of "those who believe, as I do, that our Association has no justifiable cause for thinking that its work is accomplished; that it had better settle its worldly affairs and compose its robes about it in a becoming fashion, before lying down to die."

The last visit to York was in 1906, when Sir Ray Lankester was the President. The British Association therefore returns to its birthplace after an interval of twenty-six years. During this period every branch of science has progressed enormously, and many new sciences have grown up. The past thirty years have also been notable for the growth of popular interest in science. The influence and prestige of the British Association has thus still further been enhanced; and the words with which Sir Douglas Galton concluded his address in 1895—"We exhibit no symptoms of decay" are as true to-day, as the British Association embarks on its second century.

The inaugural general meeting will take place in Exhibition Buildings on Wednesday evening, August 31st, at 8.30, when Sir Alfred Ewing will deliver an address on "An Engineer's Outlook." There will be evening discourses on September 2nd and September 6th at 8 p.m. The first discourse will be by Sir Arthur W. Hill on "Plant Products of the Empire in Relation to Human Needs." The second will be by Mr. C. C. Paterson on "Uses of the Photo-electric Cell." On September 5th at 5.30, a public lecture will be given by Mr. H. E. Wimperis on "Speed in Flight." An evening reception will be given by the Lord Mayor and Sheriff of York on September 1st. As in previous years several excursions have been arranged, and there will also be visits to some of the local works and factories. An excursion to Ravenstonedale is being arranged by the Yorkshire Geological Society for the study of Howgill Fells, the Lake District Border and the Borough areas, to take place from September 8th to 12th. This will be under the direction of Professor W. G. Fearnsides, and will be of particular interest to members of Section G (Geology).

The subjects of the presidential addresses in the sectional proceedings are given overleaf, with brief biographical notes. The subjects for discussion in individual sections are as follows:—

In the mathematical section papers will be read on the control of humidity in industrial processes at a meeting to be held jointly with the engineering section. There will be a discussion with the psychology section on the relation of physical stimuli and sensory events. Papers will also be read on super-conductivity, and short-wave reception by frame aerials.

Subjects for discussion by the chemistry section include stereo-chemistry, water-pollution with special reference to the present Tees investigations, and the properties of mixtures.

The relation of the millsone grid to the carboniferous limestone will be among the topics of discussion by the geology section, who will also consider the origin of igneous rocks, the granity of Lundy Island, and the carbonicola succession in the concealed coalfield of East Yorkshire.

The zoology section will combine with the section of anthropology in discussions on the primates and

The Archbishop of York's Message

As one who was closely concerned with the launching of DISCOVERY, I am happy to write these few lines to commend it and to wish it well. I believe it to be fulfilling a most useful function in making available for the public sound knowledge concerning recent scientific advances and other developments of human knowledge.

William Ebor:

Bishopthorpe, York.

early man, and with the section of botany on the biological balance in fresh water. In a paper on plankton research in the service of the fishing industry, Professor A. C. Hardy will describe experiments with the plankton indicator, carried out on a number of different fishing grounds by herring drifters and patrol ships. During 1930 and 1931 over five hundred records of the quantity of fish caught were obtained, together with samples of plankton taken at the same time. Reference will be made to the beginning of an experiment in charting the plankton on a broad scale by means of continuous recorders on steamship lines across the North Sea, with a view to forecasting the conditions on the fishing grounds later in seasons. An attempt will be made to estimate the commercial value to the industry of the results so far obtained with the plankton indicator.

Papers on the physical setting and historical geography of York are appropriately among those to be read to the geography section, which will also discuss the human geography of the north Yorkshire moors, the industrial geography of the north-east coast, the textile industry of the Pennines, the Hull fishing industry and the physique of the Chiltern plateau in relation to human settlement.

The section of economic science and statistics will hear addresses on the reconciliation of producer and consumer in the co-operative movement, the location of industries, the effects of the world depression on the banking systems of western Europe, agriculture and world change, and the economic position of Japan. In co-operation with this and other sections, a department of industrial co-operation will present papers on the preparation and uses of statistics for the business executive, the selection, training and placing of administrative personnel, and the possibilities and limitations of the measurement of human effort as a basis of monetary reward.

The control of humidity in industrial processes will be discussed by the engineering section, jointly with the mathematicians. Other subjects will include the electric propulsion of ships, a new system of lighting in coal mines, and railway traction by steam, oil engine and electric power.

Soviet Engineering.

In a review of Soviet engineering enterprise, Mr. A. P. M. Fleming will consider what bearing the experiment at present conducted in Russia has on world economic conditions. This review is made from a first-hand study of conditions in Russia. The Soviet plan envisages the development of the natural resources of one-sixth of the earth's land surface, comprising practically all the kinds of material wealth necessary for human well-being, and the distribution of these resources to the 150 millions of people confined within its borders. The carrying out of the Russian enterprise rests upon an engineering basis, and especially upon the provision of an abundant supply of cheap power. The basic factors include the pursuit of hydro-electric developments on a large scale, the establishment of the manufacturing facilities for engineering plant, the setting up of metallurgical and other enterprises required for the supply of raw materials, and the application of the most advanced methods of engineering to agricultural developments, transport and communication.

New Work at Ancient Gaza.

"Who were the Romans?" is among the questions which will engage the section of anthropology, who will also discuss domestic architecture under the Roman Empire. Accounts will be heard of recent discoveries at Birdoswald, and the latest excavations at Samaria. Sir Flinders Petrie will give a paper on copper and bronze in Palestine. He will deal with the excavation of Ancient Gaza in 1932, which is on the palace site and the cemetries.

The sessions of the physiology section will not be held this year in view of the international congress which is to take place simultaneously in Rome.

The psychologists will join with the mathematics section in discussions on the quantitative relation of physical stimuli, clinical psychology, the psychology of acquired characteristics, learning and instinct, and visual and auditory phenomena.

An afternoon lecture on plant diseases in the Empire is contemplated for the botany section. A special programme will also be presented by a department of forestry, of which the chairman, Mr. T. B. Ponsonby, will deliver an address on a system of forestry for the British Isles.

In the section of educational science there will be papers on the scope and equipment for science teaching in senior schools, the film in education, the university movement in Yorkshire, and the importance of science in the education of boys and girls.

A discussion on the increased use of mechanical power will be an important feature of the proceedings of the section of agriculture. The distribution of agricultural products, the nature and importance of the clay fraction of soils, and questions of crop production will also receive attention.

The British Association announces that arrangements have been made for the annual meeting to be held in Leicester in 1933 and in Aberdeen in 1934.

Pictures under the Searchlight of Science.

By A. P. Laurie, LL.D., F.C.S.

In spite of neglect by experts and connoisseurs, the application of scientific methods to the study of pictures is rapidly growing. Valuable results have been obtained in detecting forgeries and in revealing the extent of repainting and touching up. Some of the methods employed are described by Professor Laurie.

THERE are several enthusiastic workers in different countries, who are engaged in the scientific investigation of pictures. England, Holland, Germany, France and America are all well represented. In spite of the valuable results obtained, the accepted experts and connoisseurs, and those who buy and sell pictures, still hold aloof and are very unwilling to accept scientific methods of enquiry. The connoisseurs are apt to regard scientific workers as being rivals in their own field, and do not realize that they are in reality valuable assistants, supplying them with facts and with new weapons which assist them in their work.

Deceiving the Connoisseurs.

The successful placing and attribution of a picture requires a highly specialized knowledge, and no one man can claim to be an expert except for one country and period. He must be thoroughly acquainted with heraldry, costume, architecture, and scenery of the period and country selected, and must have a wide and intimate knowledge of the pictures of the period, an eye and eye-memory trained by constant study of pictures, and that flaire which must be a natural gift trained by accurate observation, which enables him almost instinctively to place a picture. This means a lifelong study, and it is impossible for the scientific specialist to claim to rival this kind of knowledge. At the same time it is possible for an expert of this kind to make extraordinary blunders, to be deceived by brilliant forgeries, and for one expert to differ absolutely from another.

A very good example of how experts can be deceived occurred recently in America in another department of art, namely statuary. A group of Italian dealers employed a clever sculptor to make forgeries of the great Italian Masters, and after suitable ageing, and having had them certified as genuine by German experts, they took them to America and sold them for fabulous sums to American museums. If the scientific expert had been called in these frauds would have been impossible. Slow chemical changes, passing in from the surface in definite stages, take place in old marble which could not be imitated by the forger, and the ultra-violet ray is a powerful weapon for distinguishing between old and new marble.

A famous forger of old Italian pictures, Ioni of Sienna, has published an autobiography in which he describes his forgeries and how he deceived the experts. A chemical examination of these pictures would have shown that they were modern and could not have been painted in the fifteenth century. It is difficult to draw the line between repainting and forgery. Old Masters have always been touched up more or less, and on the other hand a ghost of a picture may have been almost entirely repainted.

A patient, exhaustive scientific investigation is the only way to get definite evidence on such matters, and it is only the scientific investigator who gets to learn the ingenious methods employed by forgers. Scientific investigation, then, supplies the connoisseur with definite facts to assist him in his judgment. In addition it can supply him with valuable assistance, by photographs taken with a magnifying camera and taken in a slanting light, with X-ray photographs and photographs taken under ultra-violet light. All these methods supply a most intimate knowledge of a picture and on occasions give surprising results.

The recognised methods are : The patient examination of the surface of the picture under the microscope ; the chemical and physical examination of the pigments and mediums used in painting the picture ; the use of the magnifying camera to study brushwork ; the use of ultra-violet light to reveal repaintings ; the use of X-rays to reveal under painting and give other useful information. Signatures, of course, should never be accepted without a scientific report. All or any of these methods may be applied to one picture and a useful report obtained.

Use of the Microscope.

The first and most important examination of a picture is with the microscope, which should be arranged to travel on a long horizontal bar. Repaintings are readily detected, the paint bridging old cracks, an idea of the age of the picture obtained from the appearance of the pigments, and some of the pigments themselves identified by their appearance under the microscope. An exhaustive examination of this kind is the preliminary to further investigation. Professor Gräff, of Munich, has specialized in this work. The next step is to examine the pigments by means of tiny specks removed with the point of a hypodermic needle. These are subjected to optical

and chemical examination under the microscope. Modern pigments are identified, and among old pigments some were used at definite periods, which enables one to approximate to a date in certain cases. Professor Eibner has recently published an exhaustive monograph on the microchemical identification of pigments and mediums.

Samples are also taken where white lead has been used, the white lead dissolved by acid and the film subjected to an optical examination and to staining solutions. Oil can be distinguished from egg and assistance given in determining the date of the picture by measuring the refractive index of the oil. X-ray shadowgraphs give information about under painting and may reveal other useful facts, and ultra-violet light reveals repairs and repainting.

The final result of all these methods is to supply a lot of data which are invaluable to the connoisseur, in addition to proving actual fraud when it occurs. An accurate knowledge of the extent of repainting is very important. Many a genuine Old Master has failed of recognition because of the daubing done by restorers. Photomicrographs of low magnification, about two diameters, are useful in revealing weakness in drawing and are especially valuable in the attribution of pictures with a marked brushwork, like those of Velazquez, Rembrandt, and Frans Hals. The time has come for an exhaustive re-examination of the pictures attributed to Rembrandt. For this the photomicrograph is invaluable, distinguishing sharply between the pictures by Rembrandt and the pictures by his pupils. Any one or all these methods of enquiry may be applied to one picture.

There is a good deal of misconception about the possibilities and limitations of X-ray photography. The photograph obtained is due to the shadows caused by the varying opacity of the pigment layers. This depends on the nature of the pigment itself (pigments containing a constituent of a high atomic weight, like white lead or vermilion, are very opaque), the thickness of the pigment larger, and the closeness of the particles of the pigment to each other.

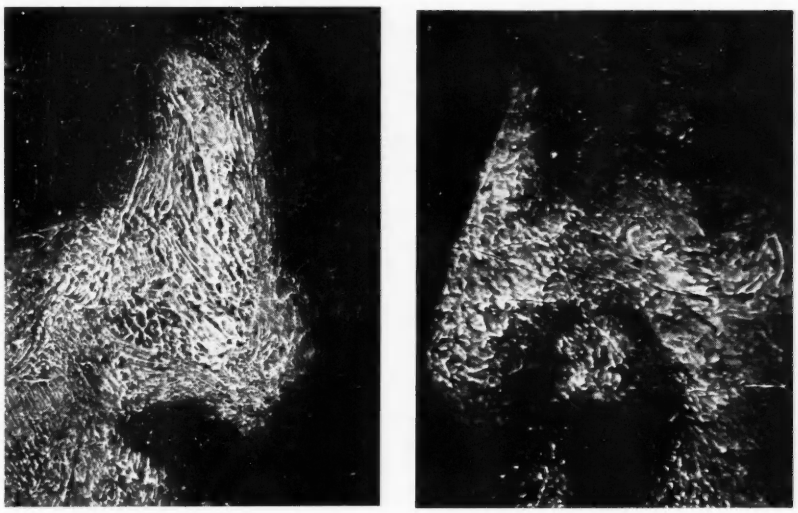
Pigments of an organic nature, usually struck on an alumina base like crimson and madder lake, are very transparent. It has been stated quite incorrectly that modern pigments consist of coal tar dyes and are, therefore, more transparent than old pigments. The artist's paint box contains many pigments used since the time of Pliny, the earth colours, the blacks, white lead and vermillion, and there were probably more vegetable lakes used by the Dutch painters of the seventeenth century than are used to-day, while modern pigments like chrome yellow are very opaque.

It is claimed that modern paint is more transparent to X-rays, but I have seen no demonstration of this. It is true that they are more finely ground and in many cases extended by the introduction of alumina and similar substances of low X-ray opacity to float the pigment in the oil, and that repaint by a restorer is often very thinly laid on, and is of the nature of an

WHAT ULTRA-VIOLET PHOTOGRAPHY REVEALS.

(Left).—A picture in the Kaiser Friedrich Museum. (Centre).—A photograph of the same picture taken by ultra-violet light, showing the repainting done by a restorer. (Right).—The picture after the repaintings have been removed. The photographs are lent by Professor Ruhemann.

oil or varnish stain. But the assumption that what the X-ray fails to register is a modern addition is a very dangerous one. The strangest superstitions have grown up round X-ray photography of pictures. Legitimately used it is a useful adjunct to other methods of examination. The Fogg Museum has for some years been engaged in taking X-ray photographs in galleries all over the world, and Mr. Burroughs has produced a series of X-ray photographs of Rembrandts of great interest.



PHOTOMICROGRAPHS OF BRUSHWORK.

(Left).—A photograph of the nose of the portrait of Titus by Rembrandt, in the Wallace Collection. (Right)—Photomicrograph of the nose of "The Man With Pearls in His Hat." A portrait at Dresden which is attributed to Rembrandt, but which the photomicrograph reveals as a forgery or repainting

The pictures here reproduced have been chosen to illustrate some of the methods of enquiry applied to old pictures. The three photographs to illustrate the use of ultra-violet photographs are of a picture in the Kaiser Friedrich Museum. The first photograph shows the picture. The second, taken by ultra-violet light, shows the repainting done by some restorer. The third shows the picture after these repaintings had been removed. The defects in the original picture which required repair can now be clearly seen. Instead of carefully stippling them in, the restorer had practically repainted the whole face.

The Metropolitan Museum, New York, has recently published a monograph on the application of ultra-violet light to the study of various museum objects. The next two illustrations are of interest as showing what can be revealed by photomicrographs of brushwork. Rembrandt's heavy impasto is very characteristic, the brush dragging on the stiff white lead but always with intention; Rembrandt's brush is always drawing, and every touch has a meaning.

This is clearly illustrated in the photograph of the nose of the portrait of Titus in the Wallace Collection. There is at Dresden a portrait of a man with a hat ornamented with pearls which is at present an accepted Rembrandt. The photomicrograph of the nose reveals a heavy lumping on of paint which is quite meaningless and the shadows painted on the top. At the period when this picture is supposed to have been painted, Rembrandt dragged his high lights over dark underpainting. The picture is probably either a forgery or has been heavily repainted.

The following may be taken as a typical example of the kind of report that can be obtained on a picture. "This picture on panel, painted in tempera, is a genuine example of the late fifteenth century Italian school. The shadows of the face have been slightly retouched by a restorer in oil paint. The ultra-violet light reveals a repair on the neck. The microscope shows that this portion has been repainted, and the fine crackle of the gesso skilfully painted in by hand. The X-ray photo reveals under this portion that the panel had been badly attacked by the wood beetle and the holes stopped by white lead. The destruction of this portion had necessitated repainting.

"The blue addition to the drapery is revealed by the X-ray to be a later addition, the underlying design being clearly visible. The blue used is Azurite, which was a fashionable blue from about 1480 to about 1650 when it disappeared from the artist's paintbox. This addition is painted in an oil medium, and the refractive index of the oil indicates a date about 1600."

Another department where much more scientific control is needed is the cleaning of pictures. An important picture should be examined minutely over the whole surface with the microscope before being cleaned, to note where the artist has added delicate glazes and where there is repaint. Ultra-violet photographs are also useful for showing repaint. During cleaning the microscope should be used to check results. An injury done by excessive cleaning can never be replaced.

Who's Who at the York Meeting

The sectional meetings of the British Association will be held daily throughout the first week in September. The subjects of the presidential addresses are given below, together with brief biographical notes.

THE presidential address to Section A (Mathematics and Physical Sciences) will be on "Physics and Prospecting for Minerals," and will be delivered by Professor A. O. Rankine, who has been professor of physics in the Imperial College of Science since 1919. He is also hon. secretary of the Institute of Physics and president of the Optical Society. Professor Rankine was chief research assistant at the Admiralty Experimental Station, Harwich, from 1917 to 1918.

Aspects of Stereo-Chemistry.

Dr. W. H. Mills, F.R.S., who will give the presidential address to Section B (Chemistry) on "Some Aspects of Stereo-Chemistry," is reader of stereo-chemistry in the University of Cambridge. He was head of the chemical department of the Northern Polytechnic Institute from 1902-12, and received the Chemical Society's Longstaff medal in 1930.

"The Ice Age and Man" will be the title of Professor P. G. H. Boswell's presidential address to Section C (Geology). The president has been professor of geology in the Imperial College of Science since 1930. From 1914-17 he was demonstrator in geology at the Royal College of Science, and George Herdman professor of geology in the University of Liverpool from 1917-30. During the war, Professor Boswell was scientific advisor to the Ministry of Munitions.

The Right Hon. Lord Rothschild, F.R.S., is to give the presidential address to Section D (Zoology). Lord Rothschild has been a trustee of the British Museum since 1899, and was elected to a fellowship of the Royal Society in 1911. He is the author of "The Avifauna of Laysan."

The presidential address to Section E (Geography) will be given by Professor H. J. Fleure, whose subject will be "The Geographical Study of World Problems." Dr. Fleure is professor of geography at Manchester University and is hon. secretary of the Geographical Association. He was research student at the University of Zurich from 1903-4, and was later professor of geography and anthropology in the University College of Wales. Professor Fleure's many publications include "The Survival of Paleolithic Types," "The Geographic Aspects of Recent Treaties," "The Races of Man" and "The Corridors of Time."

"Britain's Access to Overseas Markets" will be the title of Professor R. B. Forrester's address to Section F (Economic Science). He is professor of economics in the London School of Economics and Political Science, and was formerly a reader in commerce and industry.

Professor Miles Walker, F.R.S., will speak to the Section G (Engineering) on "The Call to the Engineer to Manage the World." Dr. Walker has been professor of electrical engineering in the University of Manchester since 1912. He was first educated for the law, and practiced in London from 1890-4. He was later sent to America by the British Westinghouse Co. with other British engineers, to gain an insight into American manufacturing methods.

The presidential address to Section H (Anthropology) is to be given by Dr. D. Randall MacIver on "The Place of Archaeology as a Science, and Some Practical Problems in its Development." Dr. MacIver has for many years been engaged in archaeological work. From 1900-6 he was Laycock student of Egyptology at Worcester College, Oxford, and from 1907-11 he was director of the Coxe Expedition of the University of Philadelphia to Egypt and the Sudan. Dr. MacIver was librarian of the American Geographical Society from 1911-14, and after serving in the war began research work in Italy in which he has since been engaged.

Professor Beatrice Edgell will give the presidential address to Section J (Psychology), her title being "Current Constructive Theories in Psychology." Dr. Edgell is professor of psychology at Bedford College, University of London, and was a member of the Senate from 1906-10.

"The Growing Tree" is the title of Professor J. H. Priestley's address to Section K (Botany). Professor Priestley has been professor of botany in the University of Leeds since 1911. From 1905-11 he was head of the botanic department at Bristol University and was consulting botanist to the Bath and West and Southern Counties Society from 1910-11.

Science in the Schools.

"The Advancement of Science in Schools: Its Magnitude, Direction and Sense" is the subject on which Mr. W. M. Heller will address Section L (Educational Science).

Section M (Agriculture) will be addressed by Professor R. G. White on "Sheep Farming: A Distinctive Feature of British Agriculture." Professor White occupies the chair of Agriculture in the University College of North Wales.

A New Crustacean in England.

By A. G. Lowndes, M.A., F.L.S.

The author's recent discovery of a minute crustacean hitherto unrecorded in the British Isles was briefly mentioned in DISCOVERY *last month. We now publish a full account of "Bathynella" and of the way in which Mr. Lowndes came upon it unexpectedly in a stone quarry near Bath. The discovery is of outstanding importance to zoology.*

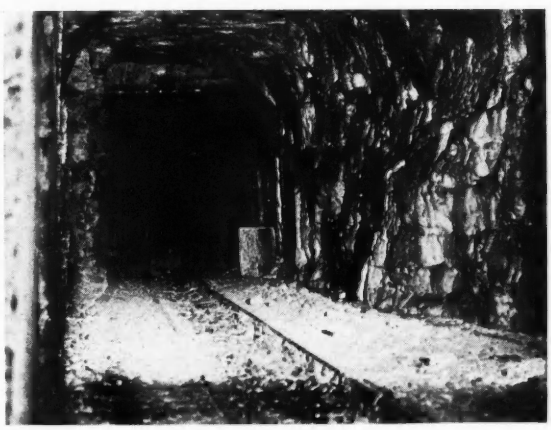
THE discovery of *Bathynella* within the British Isles represents a succession of perfectly simple coincidences. In 1922 I organized an expedition from Marlborough College to the Bath Oolite quarries at Corsham near Bath. In 1927, when I was carrying out a more or less continuous survey of a certain Copepod, *Cyclops*, I again visited the same quarries. The work on hand at the time was the investigation of the relationship between the occurrence of Cyclops and the hydrogen ion concentration of the water in which they lived. Remembering from the previous expedition the occurrence of water within the quarries I thought it more than likely that one would obtain some interesting information.

At the time when I visited the quarry for the second time, in June, the quarries were remarkably dry. A quarryman told me that there was no water down the quarries with the exception of that which occurred in a few isolated tubs. I then persuaded the quarryman to take me to one of the tubs, and there I took samples of the water and made a search with the ordinary pond-life nets for anything living in the water. The quarries are completely underground and there is no light. The investigation therefore had to be carried out on my return to Marlborough. There I searched through the collection and picked out the various species of Cyclops, but put any other animals on one side. I happened to notice two minute crustacea about which I knew nothing, and placed these in a bottle in formalin simply labelled "Corsham, June 10th, 1927."

In 1931, quite by chance, I happened to look at the specimens again. The circumstances were as follows: One of my biologists asked me to go out with him to collect some mycetozoa, which I agreed to do. The only tin suitable for collecting mycetozoa happened to be one in which the bottle with the small crustacea had been placed by a laboratory steward. On the next day, Sunday, when replacing the bottles in the tin, I happened to notice these two crustacea and thought I would investigate them a little further.

In the interval between 1927 and 1931 I had several communications with the late Professor G. O. Sars, whose name is, of course, a household word to all students of crustacea. He had sent me a paper of his on *Parabathynella*, which had been obtained in the Malay Peninsula and forwarded to Professor Sars for identification and description. On examining the two small crustacea I was astonished to find that they were undoubtedly either Parabathynella or some closely related animal, and I sent the specimens without further delay to Dr. Calman, F.R.S., Keeper of Zoology at the British Museum (Natural History). He confirmed my diagnosis and stated that to the best of his knowledge the specimens were *Bathynella chappuisi*. At the same time the specimens were immature and not well preserved.

The occurrence of Bathynella within the British Isles was considered to be so remarkable that it was felt that confirmation of the record was in every way desirable if not essential. I accordingly started to make a thorough search for the reappearance of the animal. Actually this entailed a somewhat laborious search of the quarries and it was not until June 15th, 1932, that I again found this animal, and found it in the living state.



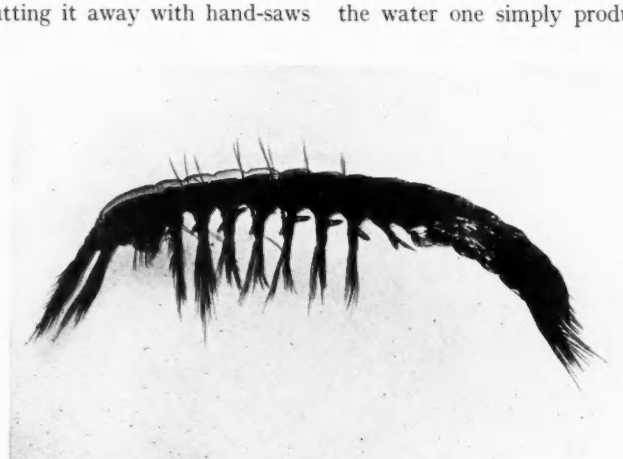
WHERE BATHYNELLA WAS DISCOVERED.

A view of the tub in the underground working where the author discovered specimens of Bathynella. The animal occurs in no other part of the quarry.

Travelling by road from Bath to Corsham one cannot help noticing the huge stacks of building stone and also the various places in which the stone is being dressed on either side of the road. The stone is Bath oolite, which is quarried

also at Portland. The original quarries from which it is taken date back to remote history. The true nature of the stone was only revealed, however, through the cutting of the Box Tunnel. Really the quarries are not quarries in the ordinary sense, for they are mines consisting of many miles of tunnelling. Towards Bath the tunnellings can be entered at ground level, but at Corsham entrance is by means of sloping shafts, for there they are nearly 100 feet below the surface. The tunnellings are very roomy and in many cases large quantities of stone are stacked there. They contain some sixty miles of trolley lines and there is no lighting of any description. In various places air shafts have been sunk and in other places wells have been dug, but in many cases there are the remains of old wells which were let down originally from the surface.

Some of the old wells in the workings are of considerable age and interest. Originally they all had some sort of windlass and cover, but in most cases the cover has gone and the windlass has decayed and fallen in. The tunnels are therefore no place in which to venture either without a guide or a light. At the bottom there is a certain amount of water, varying, of course, with the wetness or dryness of the season, but in addition springs occasionally occur or water percolates through the joints of the rock. In the past it was usual for quarrymen to place tubs where they would catch the water. The whole of the stone is removed by cutting it away with hand-saws and then dragging out the large blocks by hand cranes. It is then placed on one of the trolleys which are drawn by horses to the bottom of the sloping shafts. The trolleys, often carrying a block of stone weighing about ten tons, are then hauled to the surface by machinery. The hand-saws must be kept wet and not greased, hence the collecting of available water in tubs.



BATHYNELLA CHAPPUISI.

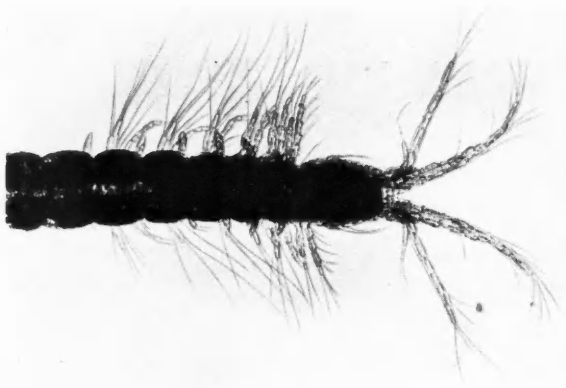
A lateral view of the crustacean. The animal is of minute size, quite colourless and almost transparent. Like many of the underground crustacea it is blind.

The quarries thus contain a number of likely places such as tubs, wells and puddles in which Bathynella might occur. Knowing that it had been obtained originally from a tub I first started investigating as many as possible. For this purpose I had to obtain the services of a new guide, for, of course, only one thoroughly acquainted with the quarries and their intricate windings could venture down with any safety. Investigation of a large number of tubs failed to yield any specimens of Bathynella. Moreover, my guide informed me that it was pretty certain the original tub had been destroyed. On June 15th, after investigating a number of tubs—and by this time my hopes of obtaining Bathynella were very definitely waning—I happened to come across a tunnel which we had not yet visited. My guide told me he knew nothing of this tunnel and he had never been there before. By some strange intuition I decided we would go along it, and I then came across what I knew at once to be the original tub from which I had obtained Bathynella.

I collected from the tub, and on returning to Marlborough after five minutes' search through the collection I obtained half-a-dozen specimens of this elusive animal. From this it is concluded that Bathynella has remained in this tub ever since 1927, and judging by the number of specimens obtained on two subsequent occasions from the tub the animal seems to be well at home. So far it would appear, however, that Bathynella occurs in no other part of the quarry. This is extremely unlikely, but it must be remembered that the floor of these quarries is covered by a very finely divided silt, and on stirring the water one simply produces a white cloudy mass of water in which it would be extremely difficult to find minute crustacea.

One would naturally ask the question, if Bathynella lives in these small isolated tubs, what is its food and where does it obtain its food from, and finally how did it get there? Living in these tunnels is a strange association of animals. Practically all the tubs and the wells contain crustacea of some kind, such as *Asellus cavaticus*, at least two species of *Niphargus* and various species of Cyclops. In addition, since men are or have been working in the

quarries, there are other animals such as rats. Again, one finds various kinds of insects which may be taken down by the horses or possibly fly down the air shafts. Finally there are masses of debris in the form of rotting wood which originally formed sleepers or props. In some cases the tubs contain leaves which have obviously blown down the air shafts. There is then no scarcity of food for Bathynella.



THE HEAD AND FRONT END.

In appearance Bathynella differs from the crabs and lobsters. It is elongated and segmented almost throughout its length, and somewhat resembles the centipedes.

Bathynella belongs to the group of crustacea known as the *Syncarida*. The animal itself is of a minute size, about 1/25th of an inch long. It is quite colourless and almost transparent, and like so many of the underground crustacea it is blind. The Syncarida themselves are the second division of the *Malacostraca* which contains such well-known animals as the crabs, lobsters, prawns, shrimps, and many other animals probably known only to students of that particular group. The history of the Syncarida itself is a remarkably interesting one. We owe our present classification of the Malacostraca almost entirely to the researches of Dr. Calman himself, and one can only refer to these very briefly here. The Syncarida were first described from fossil remains which occurred in the Carboniferous deposits.

About the year 1880 Professor Vejdovsky obtained from a well in Prague two specimens of a minute crustacean which he was unable to refer to any recognized group. In 1895 the Tasmanian shrimps, Anaspedes, were discovered which occur only in the upper streams and ponds in Tasmania. In 1900 Dr. Calman examined one of Professor Vejdovsky's specimens and pointed out that it was closely related to the Tasmanian shrimp and that both were in reality Syncaridae. But owing to the fact that Vejdovsky had only obtained two specimens, and these were extremely small, Dr. Calman's theory was not universally accepted. In 1913, however, Bathynella was again obtained in fairly large quantities from Switzerland by Dr. P. A. Chappuis. It was then possible to investigate the animal fairly thoroughly, and Dr. Calman's theory was proved beyond any doubt. Since then a second species has been described from Switzerland by Dr. Delachaux, and it is to this second species that the Corsham specimens should be referred.

Unlike the crabs and lobsters, the Syncarida possess no outer shell covering the thorax. In appearance they also differ, being elongated and segmented almost throughout their length, and except for their appendages they resemble centipedes. In looking for Bathynella one came across a number of other crustacea, some of which have proved to be of considerable interest, but are outside the scope of this article. On one occasion one of the wells was opened up specially for me, and from this I obtained an interesting Ostracod, namely, *Herpetocypris palpiger*, which was a species new to science. Again, within the immediate vicinity of Bathynella, in fact in the puddles formed by the overflow of the Bathynella tub, I came across an exceedingly beautiful little Ostracod belonging to the genus Candona, which was not more than 1/50th inch long and can best be described as a minute living pearl. This species was also new to science and it has been described under the name of *Candona wedgwoodii*.

The crustacea occurring in these quarries fall into one of two categories. The Cyclopids and the Harpacticids are, of course, represented in ponds and streams on the surface. *Leptocyclops agilis* is probably the best known of all Cyclopids, being cosmopolitan in its distribution. It is recorded practically from the Arctic to the Antarctic, and occurs at almost any height above sea level. In fact it occurs in any place where there is fresh water, and its occurrence underground associated with Bathynella is but another example of this universal distribution. The Niphargus is a common Amphipod and occurs abundantly in many of the wells of the Marlborough district. All these crustacea have without doubt found their way into the Corsham quarries from above, but with Bathynella it is probably quite a different case. Except in Tasmania the Syncarida are never found

in the surface waters, and in Europe Bathynella has only been obtained from underground quarries and caverns. Since it never occurs at the surface there is every reason to believe that its present habitat is underground.

It is interesting to hazard a guess as to how Bathynella came to occur in its present situation at Corsham. The tub in question was placed there some forty years ago to catch the drippings of water from the roof. These have obviously come from one of the fissures of the underlying rocks, and it is in these fissures that one would expect to find Bathynella. Not far from the tub there is a small subsidiary air shaft, and within the tub itself a few leaves from the surface are always found. It is possible that one of the animals dropped into the tub and has gradually given rise to the race at present living there. The proximity of the air shaft may have some effect in providing suitable food.

Apart from the interest of the record, the occurrence of Bathynella should be invaluable to zoology in general for there are many points in its life history which require further investigation. If a ready supply of these animals is now available, as I sincerely hope it is, the requisite material can be supplied for various specialists interested in those particular points.

I cannot close this short article without expressing my gratitude to the managing director of the Bath & Portland Stone Firms, Ltd., Mr. Alfred Taylor, and also to Mr. Chaffey, and various other workers in the quarry, all of whom have been most willing to render me every assistance possible. Finally, I would add that the rediscovery of Bathynella was almost entirely due to the interest and enthusiasm shown in the first discovery by Dr. Calman, to whom I would tend my most sincere thanks.

Discoveries on Pleasure Cruises.

MODERN pleasure cruising has a very real value for students of history and archaeology. And there is added interest in following up the discoveries made on the cruise by visits to libraries, picture galleries and museums at home. This photograph of the Nelson Cemetery at Gibraltar, taken during a Canadian Pacific cruise by the S.S. *Montclare* to the Atlantic Isles, is an example of the little-known places of interest which can be visited abroad and followed up afterwards in London. In the Nelson Cemetery rest some of the dead brought ashore after the Battle of Trafalgar. This modest burial place is not easy to discover, and may easily be passed unnoticed. Many visitors have never seen it at all. For those who have, the place has interesting associations with the Naval Shrine in St. Paul's Cathedral, and with quite small mementos in the United Services Museum, Whitehall.

Nelson's body, preserved in spirit, came home in an oaken cask. Some of the spirit from the cask is in a flask in the Museum, and there is also a piece of a stave, and a fragment of the hardwood support made for his head when he was brought home to lie in state at Greenwich. In that Museum also is a scrap of Nelson's handwriting done with his left hand after the loss of his arm at Santa Cruz—a port now visited by pleasure cruising liners to the Atlantic Isles. Such relics are to be discovered in the London museums.

The modern cruise to Gibraltar is incredibly quick compared with Lord Nelson's last voyage home. Trafalgar was fought on October 21st, 1805, and Nelson's body was not landed in England until December 4th. It is interesting to note that the names of the officers who were buried at Gibraltar are recorded in a diary kept by George Coppen, a survivor, and now in the United Services Museum. To follow up the experiences of a pleasure cruise a few hours' research in London, or in the libraries and museums of other cities, is well worth while.

[*Canadian Pacific.*

THE NELSON CEMETERY, GIBRALTAR.

Science and Industry—VII

The New Photography

By S. O. Rawling, D.Sc.

Progress in the knowledge of sensitive materials has been a feature of recent research in photography. The explanation of "sensitivity" has not yet been found, but rapid progress has been made in increasing the range of new emulsions.

MUCH could be written on the subject of photography as an implement in the hands of research workers in all kinds of scientific investigations; in this article, however, an attempt will be made to describe some recent advances in our knowledge of the nature and behaviour of photographic sensitive materials, and to indicate briefly some important new types.

Photographic Plates.

The sensitive surface of a photographic plate or film consists of a layer of gelatin in which are embedded countless millions of tiny crystals of silver halide. The most commonly used silver halide is the bromide with a small proportion of iodide in solid solution; the two halides occur together in the same crystals. They are formed by adding silver nitrate to a solution containing a soluble bromide with a little iodide. Since they are insoluble in water they form a sediment of tiny crystals as soon as the mixing process begins. The particles would clot together were it not that a little gelatin is always added specially to prevent this from happening.

During subsequent stages of manufacture the mixture is "ripened," that is to say, it is maintained at a moderate temperature for a given time during which a certain amount of growth occurs in the crystalline grains; the small grains tend to get smaller, but the larger ones become still larger. After ripening has been completed the soluble salts are removed and the resulting "emulsion," as it is called because of its milky appearance, is spread on to glass plates or celluloid. The gelatin present causes the emulsion to set to a jelly and the plates or films are then removed to special rooms to be dried.

The illustration overleaf shows the appearance of the crystalline grains. It will be noticed that they vary very much in size and appearance, according to the kind of material from which they have been taken. Photomicrographs of sections of films show that there are from ten to fifty layers of grains in a sensitive surface. The grains having been formed in darkness or non-actinic light, are usually not reduced to metallic silver when treated with a developing solution. Exposure to light, however, causes some of the grains to become vulnerable to the developer. The greater the amount of light, the greater the number of grains which are made developable, so that variation in blackness of a negative is due to variation in the number of grains of spongy silver produced by reduction of silver halide grains.

The process of development of single grains has been very carefully observed under high power microscopes, and it has been found that development always begins at a few spots, proceeding rapidly from these until the whole grain is blackened. There is never a gradual greying of the grain, nor does a grain ever stop in the half-developed condition unless the action of the developer is arrested by some outside cause.

A great deal of work on the distribution of sensitivity among individual grains has been carried out during the past twelve years. The researches of Svedberg in Sweden and of Toy at the laboratories of the British Photographic Research Association were among the first of the considerable advances which have been made in this theoretical study of photographic sensitivity. The experiments were simple but extremely laborious. Emulsions were coated so thinly that only one layer of grains was obtained on the support; definite exposures were given and the number of grains which became developable under given exposures was counted. This was done for several different sizes of grain, and the results were expressed as percentage of developable grains for various exposures. In order to obtain reliable results many hundreds of grains had to be counted.

Important Discoveries.

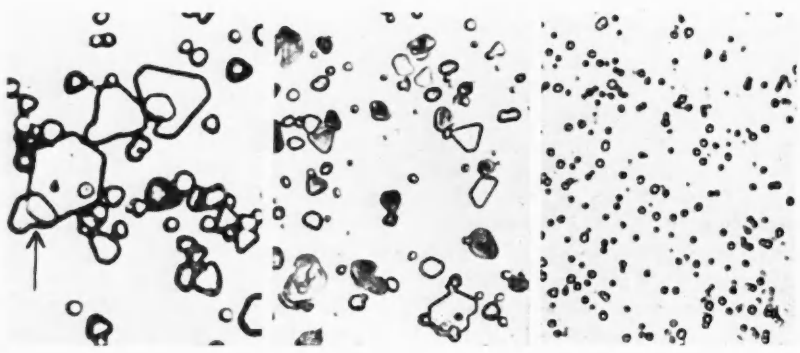
One of the most important results obtained was that in a given emulsion large grains are, on the average, more sensitive than small grains. Secondly, it was found that the large grains possess a greater range of sensitivity than smaller ones. In one experiment by Toy the range of exposure over which a considerable variation in the number of developable grains occurred was about 1 to 2,000 for the large grains, while for the small grains it was only about 1 to 30. In other words, the small grains were much more nearly alike in their behaviour than the large ones.

These results together with others of similar kind led Toy and Svedberg—independently of one another—to put forward an hypothesis concerning the distribution of sensitivity among the grains. They postulated nuclei of high sensitivity which are scattered at random among the grains. The action of light is to convert these nuclei into development centres. Each nucleus has its own individual degree of sensitivity. The presence of one development centre on a grain is sufficient to make the grain developable. Toy's results led him to the conclusion that the large grains are more sensitive than the small ones, not only because there is a greater probability for sensitivity nuclei to occur on a large surface than on a small, but also because the nuclei on large grains tend to be more sensitive.

By 1923 this hypothesis, without any very serious modification, was fairly generally accepted as fitting in with known facts. The next notable step was the discovery of a substance which probably constitutes many of the sensitivity nuclei in photographic materials. Various substances such as silver, gold and platinum when in the colloidal state have been shown to enhance the sensitivity of certain emulsions to which they have been added. Only one of these, namely, silver, is likely to occur in normally made emulsions, and for various reasons chemists have not been entirely satisfied that colloidal silver alone is responsible for the very great sensitivity of modern photographic materials.

Just prior to 1925 Dr. S. E. Sheppard and his colleagues of the Eastman Kodak Company investigated certain supplies of gelatin which were known to yield emulsions of extreme sensitivity. After a very careful search they were able to isolate minute quantities of allyl-isothiocyanate from the gelatin. The amount present was estimated at about one part in 300,000 of gelatin. This substance during the course of normal emulsion-making practice would eventually yield silver sulphide by a chain of chemical changes which we need not describe here. It was found, moreover, that minute traces of the substance found in the active gelatin when added to comparatively inert gelatins enabled very sensitive emulsions to be prepared. Thus it is now considered as extremely likely that some of the sensitivity nuclei consist, in part at least, of specks of silver sulphide. These nuclei must be formed by a process of gradual deposition of the parent substance at the surface of the grains.

Hypotheses concerning the mechanism of the working of sensitivity nuclei have been very numerous—and, so far, very unsatisfactory. Indeed, some of the principal investigations in this field have resulted in showing how the nuclei do *not* work. According to one idea a nucleus consists of some foreign substance or substances, more sensitive than silver bromide, which is decomposed on illumination yielding a development centre. This idea is not now generally accepted because the region in the spectrum for the sensitivity of an ordinary silver bromide emulsion corresponds almost exactly with the absorption band of silver bromide itself, and not with that of silver sulphide or other substance of which the nuclei are supposed to consist. It is argued from this that it is really the silver bromide which is photosensitive and not the "foreign" substance.



CRYSTALLINE GRAINS IN EMULSIONS.

(Left).—Grains from an experimental emulsion, specially prepared to yield large grains. (Centre).—Grains from a portrait emulsion. (Right).—Grains from a process emulsion used in photo-mechanical work. Magnification about 2,500 diams.

Another suggestion is that a nucleus consists of metallic silver and silver sulphide in contact with one another and with the silver bromide of the grain. This system is considered to be a voltaic cell in which silver bromide is the electrolyte and, in the dark, has a very high resistance. Light is known to diminish the electrical resistance of silver bromide, and it is supposed that when the nucleus is illuminated an electrolytic current flows round the little voltaic cell, depositing metallic silver on the silver "electrode" already existing. When sufficient

additional silver has been deposited this mass of metal—far too small to be resolved by the most powerful microscope—is supposed to be capable of behaving as a development centre.

This ingenious idea, however, does not fit in with several facts. The electrical conductivity of silver bromide is made up of two parts, one electrolytic yielding metallic silver and free bromine while the other is closely similar in type of the conductivity of metals, in which the passage of an electric current produces no decomposition of the conductor itself. It was also found that only the second type of conductivity is increased by light, and furthermore it is this second type of conductivity which follows a parallel course with photographic sensitivity over a wide range of temperature variation. On the other hand, the variation of electrolytic conductivity with temperature is of quite a different order; it is therefore almost certain that photographic sensitivity is not related to electrolytic currents in silver bromide.

The search for the explanation of photographic sensitivity still goes on and will probably occupy investigators for some time to come. On the practical side of emulsion chemistry, however, rapid progress has been made in supplying the ever widening range of sensitive materials demanded by photographers. The principle that large grains are usually more sensitive than small ones, and that sensitivity is more widely distributed among large grains than among small ones, is exploited very much by emulsion makers. Thus it is that we find in emulsions intended for portrait work the grains are widely distributed with respect to size, so that a very wide range of response to light is covered. Such an emulsion is well suited to record the moulding of features by means of delicate shades of grey. On the other hand, for photo-mechanical work in which a sudden change from white to black is required the emulsion maker supplies a fine grained emulsion in which the grains are as much alike as possible.

A PANCHROMATIC PLATE.

A photograph taken on a misty day with a panchromatic plate. Panchromatic materials are sensitive to green, yellow and red in addition to blue.

INFRA-RED PHOTOGRAPHY.

The same photograph as that below, taken with an infra-red sensitive plate and filter excluding the blue rays. The superiority in detail is very marked.

The most striking advances have been made in the direction of extending the sensitivity of emulsions so that colours other than blue and violet are recorded. When ordinary photographic plates are employed photographs of scenes or objects in which bright colours are at all dominant present considerable distortion of tone. To the eye a green field is often one of the most luminous parts of a landscape, yet in a photograph of the same scene, taken by means of ordinary negative material, the field may be rendered as a heavy grey; yellows and reds in the same way are rendered as dark tones, although they are often the most luminous colours in the original.

In 1873 H. W. Vogel discovered that photographic plates on being bathed in solutions of certain coloured substances become sensitive to light of colour approximating to that absorbed by the dye used. This discovery was the key to the problem of photographing coloured objects so as to give them their true luminosities in monochrome pictures. More important still, it opened the way to colour photography itself. Lastly, since much more light is utilized, it has recently resulted in the production of materials so sensitive to the yellow and red that snapshots may be taken at night by ordinary bright street lighting.

The extension of the sensitivity of photographic emulsions towards the longer wave-lengths of the spectrum has given rise to three distinct types of colour sensitive material. The first type includes materials in which the sensitivity has been extended

to cover the green; such materials are generally known as "orthochromatic" or "isochromatic." Materials which are sensitive to green, yellow and red in addition to the blue are termed "panchromatic." Here it may be noted that in its strict sense the word "orthochromatic" should be synonymous with "panchromatic," since it is possible to record all the colours in their "right" luminosity only when panchromatic materials are employed. Usage has, however, long attached the word to the green-sensitive type of material which was the first to be produced.

The third and latest extension of the sensitivity is into the just invisible region of the spectrum at the red end. These infra-red plates are not as a rule made sensitive to the green and orange, although they retain their sensitivity to blue; they are thus easy to manipulate in the dark room with a lamp screened by a greenish yellow safe-light filter—provided that the infra-red itself is excluded. The plates are useful in survey work since they record distant scenes through haze sufficiently thick to cause complete obscuration as far as the eye is concerned. They may also be used in photo-micrographic study of specimens which, although opaque to ordinary light, are transparent to rays in the neighbourhood of 8,000 A°. The illustrations on page 291 show a comparison between the results obtained in misty weather using a panchromatic plate and an infra-red plate. The superiority of the infra-red in rendering detail through mist is very marked.

The author is indebted to Messrs. Ilford Ltd. for permission to publish the photographs.

News and Views of Early Man

THE first International Congress of Prehistoric Sciences (on which an article by Mr. Stanley Casson will appear next month) did not fail to provide anthropologists with excitement, although hardly of so sensational a character as a section of the daily Press suggested. Professor Elliot Smith announced that the skull found in the excavation for Lloyd's building in 1925 was probably the oldest known specimen of "modern man." Professor Smith's view of its antiquity is based on a revision of the stratigraphical evidence by Miss Dorothy Garrod, who assigns it to the Mousterian period or even earlier. This conclusion has been arrived at as a result of the fact that the blue clay from which the fragments were derived is no longer regarded as post-Mousterian. When once the possibility of a Mousterian origin is recognized, certain difficulties of interpretation which arise when it is compared with Aurignacian skulls, are seen to disappear. A recent comparison made by Dr. Matthew Young between the Lloyd's skull and medieval female skulls from Glasgow reveal no reason why the former should not be regarded as essentially modern in type. Hence, as Professor Smith said, this skull as a type of "modern man" is vastly more ancient—in fact by many thousands of years—than any other known specimen of *Homo sapiens*.

Claims to Antiquity.

In making a claim for priority on behalf of "The Lady of Lloyd's," Professor Smith took the precaution of warning his audience that this pride of place depended upon the presumption that the claim to an antiquity going back far beyond Mousterian times—and indeed to an Acheulean horizon in the African series—made on behalf of the Oldoway man, admittedly *Homo sapiens*, had now been discredited. This question of the antiquity of the Oldoway skeleton, has been in dispute since the autumn of last year. Then Dr. Leakey, accompanied by Dr. Hans Reck, the discoverer of the Oldoway skull, and Mr. A. T. Hopwood of the British Museum (Natural History), visited the site and examined the evidence. The members of the expedition were prepared to admit that the flexed position of the body and the complete articulation of the bones might well point to a burial. But they have since maintained that burial was ancient and must have taken place before the complete deposition of Bed No. 2, in which it was found, since neither on the bones, nor in the place where they were found, was there any trace of the differently coloured material from the beds which are superimposed. Unhappily for Dr. Leakey's argument, Professor P. G. H. Boswell points out that an analysis of material taken from within the ribs of the skeleton, now in Germany, shows, on comparison with an analysis of samples taken from the overlying beds, material derived from Beds 3, 4 and 5. This proves conclusively that the skeleton is not earlier than late Aurignacian. It is more than possible that it is that of a modern Masai.

Among the many interesting contributions relating to early man submitted to the International Congress, few were of more moment in their bearing on man's upward progress in civilization than the account given by the Abbé Breuil of the cultural contents of the cave of Chou-Kou Tien, the home of Peking man. Although it was already well known that hearths, charcoal and traces of fire on implements had been found, the exhibit of artefacts which accompanied the paper gave members of the Congress an opportunity of forming an independent judgment on the material.

Why Do Birds Sing?

By E. W. Hendy.

Author of "The Lure of Bird Watching," etc.

The evolution of bird song has been the subject of much discussion among ornithologists. Sir Arthur Thompson has suggested that birds inherit their voices from their reptilian ancestors. This view is supported by a French watcher in a new book which contains many suggestive and original observations on this and other aspects of bird life.

ENGLISH readers will welcome an opportunity of perusing in their own language the work of a French ornithologist and bird-lover which has been "crowned" by the French Academy. M. Jacques Delamain has from his youth been a keen observer of birds in the woods and vineyards of Charente, and pursued his studies in the trenches during the War. His book* will delight not only experts but amateurs, for he has the faculty of imparting his great knowledge simply and attractively. To him birds are things of beauty, not merely biological facts.

FRIENDSHIPS AND HATREDS.

The decorations by Prentiss Taylor are reproduced from "Why Birds Sing."

The book does not, as might be surmised from the title, deal with bird song alone; in fact, the chapter on that subject takes up only some twenty-five out of three hundred pages. Much of what the author says on this subject is already well-known to British ornithologists; as Messrs. Jérôme and Jean Tharaud remark in their Introduction, France has not hitherto paid much attention to birds; "The Anglo-Saxon race, and, in a more general fashion, the Protestant races, are infinitely more interested in all this winged world than the Catholic Latins. . . . A mystic like St. Francis of Assisi . . . is only an exception to the rule," and they are "not surprised that he should be about the only one among the saints to have captivated the Protestant mind." This, as M. Delamain admits, is a somewhat controversial matter; but most people will agree that our English interest in bird-life is one of those traits which reveal the essential differences of feeling between the French (and Latin) races and our own. Meanwhile we are glad to hear of the numerous refuges established on the initiative of the French League for the Protection of Birds.

M. Delamain acknowledges freely his indebtedness to English writers such as Messrs. Edmund Selous, T. A. Coward, H. Eliot Howard, E. M. Nicholson, Lord Grey of Fallodon, Gilbert White and W. H. Hudson. His conclusions always attract us both by the freshness and delicacy of their presentation, and also because they show that in many cases his independent observation confirms the theories separately worked out by these and other investigators.

He points out that though birds are never quite silent, their winter notes, even if prompted by slumbering amorous impulse, are not yet true song, but the expression of simple emotions; there is little or no song in the winter communities; the lark sings only when he has separated from the flock. Also, permanent colonies do not produce great singers in any season; gulls and terns utter only clamorous noises. Full song he rightly declares to be an expression of complex emotions; it is passion, challenging assertiveness, and pure happiness at being alive; "A bird enjoys the note modulated by his own throat"; so Wordsworth's faith was that every flower enjoys the air it breathes.

M. Delamain's views on the evolution of bird-song are stimulating. As Sir Arthur Thomson has written, "birds inherited their voice from their reptilian ancestors, and have re-invested this legacy." Whichell, in "The Evolution of Bird Song," written thirty-seven years ago, seems also to have considered this to be a possible explanation, though when he remarks that the notes of certain birds resemble the croaking of frogs and toads he attributes this to imitation.

**Why Birds Sing.* By JACQUES DELAMAIN. Translated by RUTH and ANNA SARASON. (Gollancz. 7*s.* 6*d.*).

M. Delamain suggests that birds still preserve in their voices traces of the croaking of their saurian forebears. Even the nightingale has a batrachian croak, and the same jarring note is present in the songs and alarm cries of the thrushes, warblers and many others. "To understand the ascending evolution of their singing from a primitive cry," he says, "one must follow the successive habitats of the birds through the ages—pass from the ocean, cradle of all life, to the slime of the estuaries, to the lake of fresh water, then to the vegetation of the plains, and finally to the forest. The sea has not a single singer."

In the mud of its bays we hear the sweet calls of sandpipers, curlews and plovers; on the marshes "teals whisper in soft whistling sounds, and, for the first time, a real song appears . . . "—that of the Whooper Swan. But the true singers, the Passeres, you find only on the bank of the stream and in field, hedgerow and forest. Even there the ground birds, such as the gallinae, have not in their cries broken free from the servitude of the soil. The best singers carol in the air or from a perch. Some, even of the passeres, have not advanced beyond the repetition of a single syllable. There is an ascending scale in the beauty even of their songs; if a bird attains art it is because, endowed with a sense of the beautiful, he is able to choose the best among his notes, to link one to another and thus "achieve music and make a song gush out from a cry."

All this is suggestive and inspiring. But when M. Delamain says that "the young male, singing for the first time, *must* recall the paternal voice to which he listened last summer while still in the nest," his statement is too sweeping. That some young birds, *e.g.*, second or third broods, have thus learnt their songs from their parent, is probable; I have heard and seen immature chaffinches and robins singing imperfect songs in late summer and autumn, and a German fancier has shown that canaries, isolated in a sound-proof room with singing nightingales, adopt the nightingale's song instead of their own. But with other species it has been proved that song is entirely inherited, for young males, reared away from their own species, sing the specific song of their kind. Though the statement that the nightingale ceases singing when the young are hatched is inaccurate, it must be remembered that by the time young birds have emerged from the egg the song period of their parent is almost, and in some cases entirely ended.

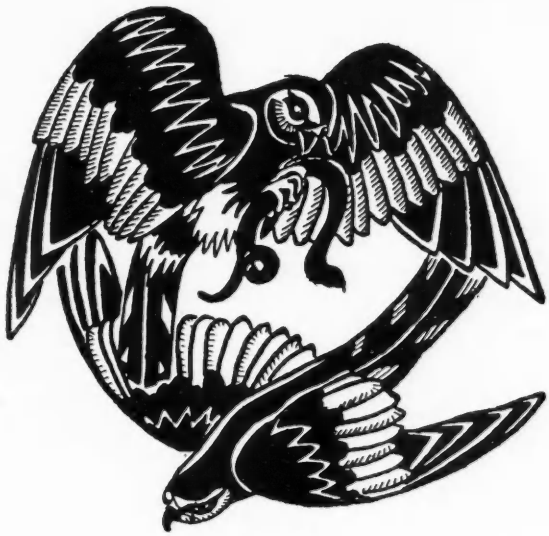
Darwin, in "The Descent of Man," stated that only small birds properly sing, though he noted a few exceptions. Why is this so? M. Delamain does not touch upon this interesting question. Whichell thought that one reason was that their mode of life had affected the development of their voices. Speaking generally, the vocal organs of the passeriformes are more complex than those of most other birds (though some members of the crow tribe, *e.g.*, the raven, possess highly developed song-organs and yet have little or no song). Whichell thought that the perching species had always been arboreal in their habits and thus dependent on the voice for inter-communication through thick foliage, and that consequently their voices would have developed. He also suggested that small individuals were naturally more vivacious than others of superior size. Certainly the smaller species of British birds are usually the most mercurial, a fact of which we are sometimes aware among non-avian individuals.

It is well known that most birds which are good singers are clothed in sober plumage, and that brightly coloured birds rarely possess a fine song. Perhaps both good song and resplendent plumage are different expressions of intense vitality; in some species it finds its outlet in music, in others in gay feathers.

THE RIVER.

There are chapters on the spring and autumn migration. M. Delamain is aware that practically all birds migrate, more or less, though the "journey may only have been from the summit of the mountain to its base, from the little hill to the adjacent valley, from the wood to the plain, from the pond to the stream. . . ." On the higher portions of

Exmoor meadow pipits swarm in summer; in winter you will not see half-a-dozen in a day's walk. It is in these seemingly insignificant movements that we see the first manifestations of the longer migrations which impel birds to cross continents and uncharted seas. As M. Delamain says, "the force is complex and obscure, and its elements are manifold. For . . . a bird is a perpetual rover, oscillating between two poles of attraction, the . . . country of nuptials and nest, to which an ineffaceable memory attaches him, and the feeding territory, necessary source of his subsistence."



TENDER BIRDS OF PREY.

As to the origin of the migratory habit, the author inclines towards some form of the glacial theory. "The amplitude of this coming and going varies with the alternation in the course of ages of glacial epochs bringing perpetual snows . . . and warm periods. . . ." This explanation is adopted, with modifications, by most modern authorities on migration, though, as Dr. Landsborough Thomson has pointed out, it is possible that migration may have been a thing of sudden growth rather than a process of gradual evolution. Mr. Coward has wisely remarked, of the various explanations, "all are theories and only theories . . . the answer to most questions is that we do not know."

In the chapter on autumn migration M. Delamain discusses how a bird of the season, migrating for the first time, can find his way. The separate migration of adults and young is believed to be the rule in many species, though the evidence is very far from complete. M. Delamain believes that "this great number of solitary (migrating) individuals . . . is in reality an enormous flock journeying in widely dispersed order; between the first and the last departed contact is never quite broken off, and in all of them the same innate impulse to migrate in autumn creates that hidden community of thought that at certain moments makes a single being of a multitude of the same blood." This is a very attractive and fascinating theory which deserves careful consideration. It seems probable that migration takes place, when weather conditions are favourable, at very high altitude, and that what we see is most often only "the lower fringe."

In a chapter on "Friendships—Hatreds" the author discusses the reasons for the sociability of some species and the antagonisms existing between others: "Instinct of sociability, consanguinity, common work, explain friendships between species, but do they suffice to interpret every case?" I agree with him that the answer to this question lies deep in the "intimate nature" of the bird. It needs a closer knowledge of its mind than that which is ours at present, and such knowledge will not be acquired in the laboratory, but in the field. Antipathies are simpler; they are, usually, instinctive hatreds of enemies.

Writing on "Nuptials," M. Delamain is confident that some birds pair for life, and he thinks that even when in winter flocks the mutual tie is still in existence in some cases. The first statement is, I think, conclusively proved as regards certain species, and there is a considerable body of evidence in support of the second, though further observations are needed; accurate identification of individuals in a flock is an extremely difficult proposition. The author's remarks on courtship and mating are evidently the result of careful and sympathetic study. With birds, as with civilized humans, "man proposes, woman disposes." "The female is not carried off like a trophy . . . she will go towards him who can stir her." We do not know "what mysterious sympathy carries the female toward that one of her suitors who seems neither strongest nor most beautiful to our own human eyes." Mutual human attractions are often equally puzzling.

To many bird-lovers August seems a dull month, for superficially it is a dead time for bird life. Song has practically ceased, and the tired landscape seems to echo the weariness of nature. M. Delamain, in some illuminating pages, shows that at this season "a profound change in bird-life is taking place." The territory acquired and defended so strenuously

during spring and early summer is being abandoned. The young birds are led to fresh woods and pastures new where food is abundant ; individuals are scattered and diffused, and a new distribution is accomplished.

The last sixty pages of this book consist of a most fascinating study of Montagu's Harriers ; M. Delamain is lucky in living in a district where these beautiful birds breed regularly. In England opportunities of observing them occur only in a few favoured and carefully protected localities. He traces their history from the arrival of the male in March, followed some ten days later by the female, through their courtship evolutions, their nesting, the rearing and training of the young in flight, down to their departure. The whole chapter is a model record of good field work and intelligent interpretation. There is not a dull sentence.

As I have not had an opportunity of reading M. Delamain's work in the original, I cannot presume to estimate the merits of this translation. I find a few obscurities, perhaps the result of attempts to interpret the French too literally. But throughout the book there are passages of great lyrical beauty which I have re-read with increasing pleasure. M. Delamain is at once a scientist and a humanist ; as a result he never descends to dry-as-dustiness or sentimentality. Such authors appeal to a wide public, and thus foster a general interest in ornithology among readers whom the specialist often fails to reach. I believe this book will become a classic.

Reviewers are sometimes censured, and rightly, for saying that an author is a follower of some earlier writer on his own subject. Such well-meant praise unconsciously attributes a lack of individuality. No one could slander M. Delamain in this manner ; but a follower need not be a slavish imitator. Constantly, while reading this book, I felt that in spirit the author was akin to one who will always be to me among the greatest of English naturalists. I mean W. H. Hudson. When I say that M. Delamain may be called " the French Hudson," I do not accuse him of imitation. I merely render him the highest praise.

The Scientists and the Laymen.

By the Hon. Stephen Coleridge.

I HAVE read with interest and also with amusement Dr. A. S. Russell's article in the August number of *Discovery*. The learned doctor was invited to " summarize the discussion " started by me in *The Times* on the nature of the Universe, but he has only summarized the assertions of the scientific gentlemen and declared his adhesion to them. He states with splendid assurance that the old idea, founded upon reason, that " the Universe stretches out everywhere to infinity is now quite dead, in fact it is damned," and he adds pontifically " the fact is that nobody believes in it any longer." This is a mis-statement of fact. Many people do believe in it.

He says, however, with great truth, that a layman " cannot picture a space finite but unbounded." I suppose I must accept the description of myself as a layman, though I did take my degree at Cambridge in applied science, and, layman or not, I claim to possess reason, and my reason certainly declines to believe that space, or anything else, can be both " finite and unbounded." If mathematical symbols lead to a statement contradictory to the reason, then reason must prevail, if not all thought becomes chaos.

Next arguing from certain observations of the spectrum it is maintained that all nebulae are receding from our part of space. Let them recede ; it does not prove anything but that they are receding. Then we are told that Sir Arthur Eddington has " calculated that the original radius of the Universe was comparatively small." How has he measured an unbounded Universe ? If it has no bounds he cannot measure its radius.

What can any reasoning person make of this sentence in Dr. Russell's article ? —" All that is implied in the sphericity of the Universe is that if we are to travel eternally we could not possibly eternally traverse new regions ; we would be bound to retrace old paths, because in fact the amount of space is measured by a finite volume." I like the " in fact " ! Here the learned doctor states as a fact what he has not proved, and what we layman, *i.e.*, persons using our reasons, deny.

Having assumed his unproved fact he can, of course, make it the basis of any fantastic conclusions his fecund invention can deduce. Naturally these men who propound Universe contrary to reason, such as a space infinite but bounded, and finite and unbounded, find no difficulty in asserting that the Universe is expanding, though they deny the existence of infinite space outside it for it to expand into. Either they take leave to dispense with human reason, or they claim that their mathematical deductions from observations of the spectrum and other experimental efforts transcend human reason. Nothing here in this world can ever dispense with or transcend human reason, not even vanity.

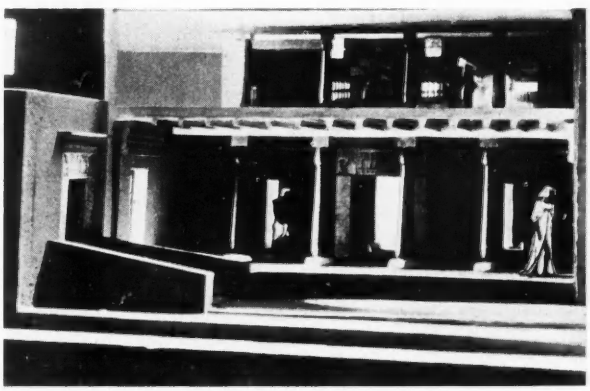
A Forgotten City of the Pharaohs.

By M. A. Chubb.

Egypt Exploration Society's Expedition.

This month the Egypt Exploration Society celebrates its jubilee. An account of the latest work at Tell el Amarna, for which the Society has lately been best known, is therefore appropriate. The excavation of this city, for a short time the home of the Pharaohs, has thrown important new light on the events of an hitherto obscure period.

For the eighth time since the war the Egypt Exploration Society sent out an expedition during the winter months to continue work at the world-famous site of Tell el Amarna in Upper Egypt, for which it holds the concession. Here the ephemeral city built by Akhenaten, Pharaoh of Egypt, once flourished for a few years and then fell into decay and was forgotten. Although the events are well known which brought about the transference of the court from Thebes, the traditional home of the eighteenth Dynasty Pharaohs, to a virgin site some 300 miles to the north, it may be well to recall very briefly the main historical and geographical points about the site before describing the excavations themselves.



A HOUSE AT TELL EL AMARNA.

Part of the model of a house owned by a prosperous member of the official class in the early fourteenth century B.C. The north hall can be seen with its painted wooden columns.

Akhenaten succeeded his father, Amenhotep III, about the year 1375 B.C. at the most critical point of the empire's progress. A mighty nation had been established for some years supreme in the eyes of the world, its upward struggle against warring rivals now long past, its power absolute, its wealth untold. Already at the death of his father, whose military vigour was dulled for lack of opportunity, the empire had slipped a point or two from its zenith at the time of his accession. Here was the moment for a fighting Pharaoh, with the ability to consolidate and perhaps add to his inheritance; instead there succeeded a young man of sensitive and unbalanced temperament, pre-occupied with a religious enthusiasm for the Aten, the Sun-disc, and stubborn in his refusal to accept the military responsibility necessary if the empire was to be saved.

The trouble between the Pharaoh and the high priests of Amon became so intense that in the sixth year of his reign, about 1370 B.C., Akhenaten left Thebes (modern Luxor) for ever, and sailed northwards to found a new capital where his religious ideals might develop unhindered. About 300 miles north of Thebes the cliffs, which keep fairly close to the Nile along its eastern bank, here recede for about three miles from the river, sweeping round in a great curve to join it again some eight miles further north, thus leaving a great semi-circular plain between. Here Akhenaten built his city, Akhetaten, and imposed on it his ideals. Here, too, he died and was buried, to be succeeded by his young son-in-law, Tutankhaten.

This young man ruled here for a few years, after which he went back to Thebes, changing his name to Tutankhamen. Probably the priests of Amon were too strong for him; possibly the strong hand of Nefertiti being removed at her death released him from a hated position—at any rate the city was deserted, except for the rabble who stayed behind to divide the houses of the great into hovels for themselves. Thus it lies to this day, preserved by the dry sand which has drifted in over walls and doorways, unharmed by any later building—except for one or two Roman structures—waiting to yield its secrets to the excavator.

The city was built along the river bank so that it is long and narrow in plan, and straggles with occasional blank stretches for a distance of some six miles. It is impossible to excavate the full extent of the site as the modern cultivation cuts off a strip varying in width from about 100 to 300 yards along the entire length of the river-front, and walls are consequently found running from the excavated houses straight into the cultivation. The main part of the capital, however, lies somewhat north of the

half-way line, and it was on this point that the expedition concentrated this season, after much necessary digging had first been done further north.

The first part of the season was taken up by the steady excavation northwards of the north part of the city in order to preserve the continuity so essential in scientific digging. This "routine" work was rewarded in several ways; for it gave us not only many finds of great beauty and interest, but also further evidence both of the architecture of the time, and indeed the trend of events during the latter part of Akhenaten's reign, for it is certain that this north part of the city was later in construction than the south and central.

A SCULPTOR'S TRIAL PIECE.

An unfinished sculpture of excellent workmanship discovered at Tell el Amarna. The youth wears on his brow the royal uraeus.

Here in the north there came to light fresh confirmation of the theory that Nefertiti fell from power towards the end of Akhenaten's reign, and staunchly defended by her own party retired to the north of the city to end her days. Here, where in the south the royal cartouches stand in dignified unity side by side, we found that in almost every case where the two cartouches appeared together, one or other had been hacked or scratched out, obviously the work of a partisan of king or queen. Again Nefertiti's cartouches appear in this region—largely on faience ornaments—alone or frequently in connection with Tutankhaten, her son-in-law, the husband of her young daughter Ankhsenpaaten, as if the royal mother had once again stepped into power.

Whatever the internal struggles and troubles of the royal house may have been, the life of the city flourished, and in the northern city were found magnificent examples of the houses of the prosperous official class of the time. With slight variations doubtless due to the owner's inclinations, these houses run so closely to type in their ground plan, method of construction and internal decoration, that it has been possible lately to construct a model in which has been combined details from various actual houses on the site, so that every part of it is scientifically correct.

It may be noted here that the poorer and even the slum houses of Tell el Amarna are usually built on exactly the same principle as the grander ones, though in miniature, without estates and cutting down the number of rooms to a minimum.

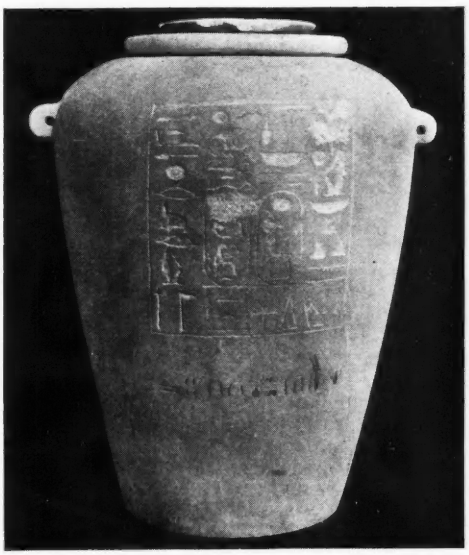
Part of a model house owned by a member of the official class in the first half of the fourteenth century B.C. is shown, with the north wall removed, in Fig. 1. In the north part of the grounds opposite the entrance gate stood the owner's private chapel, open to the sky with steps leading up to the altar; further east was an orderly grove of trees with a bench within, to the right of this a well with a circular flight of steps leading down to the water. In the south-east corner of the grounds were grouped the servants' quarters and kitchens, while along the south wall of the grounds were built spacious stables and byres. In the west courtyard stood some corn bins, into the top of which slaves mounting the steps would tip the corn, whence it could be drawn out later through a small opening in the base. The house itself consisted of a large central living room with clerestory lighting entirely surrounded by rooms which are necessarily lower in altitude. On the north and west were columned halls, on the east stairs running up to the flat roof, while on the south side of the central room were grouped the domestic quarters.

The entrance to the house can be seen on the left of Fig. 1. Although the ceilings of the excavated houses have now all disappeared, evidence for lightly columned first-floor rooms is found by the presence of loose stone column bases, lying in the ground floor rooms exactly like the fixed ones below only very much smaller, obviously having fallen through when the ceiling collapsed. Here can be seen the north hall with its painted wooden columns standing on the stone bases, the gaily painted beams, the lightly built room above, while in the centre a finely decorated lintel stands over the doorway which leads into the great central room, the tops of whose big columns can be seen protruding

to the height of the whole house ; beyond are the grille windows which light the central room.

The wooden columns have all disappeared ; possibly when the order came for the return to Thebes, the house owners removed them bodily, since wood in Egypt is so rare, and floated them up river ; possibly the ubiquitous white ant was responsible ; but the marks of the red paint which covered them and dripped down before it had dried are still clearly visible on the stone bases, where also can be seen in every case the incised diagonal lines which the builder cut to ensure the exact centering of the column when erected.

Naturally after the city was abandoned these fine houses were invaded by the rabble who had no wish or opportunity to go back to Thebes ; in some cases the bricks were removed for building activities elsewhere, but in many the far simpler expedient was resorted to of building rough partitions across the unnecessarily large rooms, thus cutting up a great house into many small ones. These walls are easily detected through their rough workmanship and the absence of bonding with the earlier walls, and an example of this is where two squatters' walls have been built right across the stone column base which was once the centre of the room. One is tempted to draw the close comparison between this and the well-known modern expedient of cutting up once prosperous Victorian drawing-rooms into three or four partitioned boarding house bedrooms !



"FOR QUEEN HATSHEPSUT."

An alabaster vase, inscribed for the Queen Hatshepsut, found more than a hundred years after her death in the King's grounds.

In the centre of the site where work began half way through the season, a complex of buildings was attacked comprising the so-called "small temple," facing west-east, the quarters and magazines of the priests who officiated there—these lay just to the south of it—and a fine group of houses and grounds immediately to the north, the whole group just east of the great palace excavated by Petrie forty odd years ago.

The temple consisted in the conventional way of three sets of pylons leading into a courtyard, the third courtyard (the easternmost) being the sanctuary proper, surrounded by an ambulatory planted with trees. Fragments of inscriptions found there gave us the name of the temple, showing that we had come upon the centre of that worship which may be said through its perfervid intensity to have led to the downfall of the empire ; the inscriptions read "the Sanctuary of the Aten, in the centre of Akhetaten." The massive remains of the northern of the twin pylons flanks the great central gateway to the temple ; beyond the gateway is the southern pylon.

A large house immediately to the north of the temple—its doorway was opposite the northern side door into the second court of the temple—must have been a residence of the king's, for besides being built on a noble scale its walls had displayed beautiful paintings of scenes from the domestic life of the royal family ; it was from this house that Petrie recovered a brilliantly coloured fresco (now in the Ashmolean Museum) of two of the princesses at a very early age sitting on a cushion at the feet of the king. Evidence that the king's well-known artistic temperament had found practical expression at Tell el Amarna may be suggested, as we found on the floor of one of the private rooms of the house a perfect set of painting materials, consisting of two rough brushes, three very fine quills for outline work, and raw paint.

In a corner of the grounds of this house some magnificent finds came to light, including several very fine sculptor's trial pieces, the most beautiful of which is shown in Fig. 2, and a complete alabaster vase, which with its lid stands over 33 cms. in height (Fig. 3). This is intensely interesting as it is inscribed for the Queen Hatshepsut who had died at Thebes more than a hundred years before.

The site all round this part of the dig is riddled with unexcavated houses. So much remains to be done at Tell el Amarna, that a find as important as that of the "Amarna letters" or as beautiful as the world-famous head of Nefertiti may be stumbled upon at any moment, letting in a fresh flood of light on the history and art of that most fascinating period.

Flying by Night: New Developments.

By Rudolf Benkendorff.

Department of Civil Aviation, Berlin.

Flying by night is a natural outcome of the international air services. In an address to the Royal Aeronautical Society, Dr. Benkendorff outlined the new problems which this development has presented to aviation.

FLYING by night presents two problems to aviation: the taking off and landing at the aerodrome, and flying from one aerodrome to another. The first task presents no completely new points. The second is purely one of navigation. The only means at one time available, the compass, was not adequate for the essential requirements of safety and regularity of service. And at night it was not possible to rely on keeping the course by the observation of objects on the ground. Night flying in Germany has seen many interesting developments in recent years. The first regular night service for the transport of passengers, freight and mails was operated between Berlin and Königsberg. The machines were fitted with wireless, and the wireless ground stations of Berlin, Danzig and Königsberg were available for the airway, which is 425 miles in length. But if safety and regularity were to be assured, airway lighting had to be instituted in order not to be solely dependent on the compass.

A close line of beacons was therefore first erected; principal airway beacons of the revolving type were placed every nine miles, and intermediate beacons with a shorter range every three miles. In addition, emergency landing fields were prepared every 50 miles—with personnel to give traffic signals to the aircraft, send weather messages, and be ready to render assistance in case of a forced landing. Even then, there was no doubt that flying along such a close line of beacons when the visibility was bad kept the pilot within dangerous vicinity of the ground. But no other solution could be found at the time, if night air traffic was not to be abandoned altogether.

Developing Night Services.

Night traffic was the only form of civil aviation which gave promise of economic development, in view of Germany's situation in the heart of Europe. The lighting of the line from Berlin to Hanover, which is 155 miles long, was built with principal airway beacons every 17 miles and electric or gas intermediate beacons every three or four miles. In building this line the beacons were placed for the first time in a bee-line.

Ideas regarding the method of airway lighting underwent a fundamental change when "blind-flying" was introduced into civil aviation, and a network of direction-finding stations was erected for the purpose of giving position, direction and course to aircraft in flight by wireless. Two technical developments which had a decisive effect on the organization of night airways became available almost at the same time.

Increased Safety.

The safety of night flying was thereby decidedly increased. The pilot was able to avoid the dangerous vicinity of the ground when the clouds were low and the visibility bad. Direction-finding provided him with a safe means of navigation which supplemented the compass. Thereby the task of airway lighting was fundamentally changed in that it was limited. The following considerations arose at the time, considerations which still form the basis of airway lighting in Germany.

If the atmospheric visibility diminishes to less than a distance of between three-quarters of a mile and one mile it is in the interest of safe flying not to fly by the beacons, but to fly "blind" at an altitude which excludes any collision with the ground or with the highest points in the neighbourhood of the air route. The aircraft can be steered to its destination with the help of the compass and direction-finding much more safely than can be done with the help of beacons. Thus, airway lighting is only of importance for atmospheric visibility greater than from three-quarters of a mile to one mile; its character had to be changed accordingly.

The flash of a strong revolving beacon is visible from 1½ miles under conditions of atmospheric visibility of one mile. If we reckon in squally weather with a maximum deflection of the aircraft to six degrees on either side of the course, a distance of 15 miles between the beacons is sufficient, when flying on the beacon line, to get in sight of the next beacon in every case. In view of these considerations, all new lines of airway lighting were constructed on the following principles: revolving beacons at intervals of 15 miles; all beacons in a bee-line between the aerodromes; only electric lighting, as gas lighting is not sufficiently intensive and too expensive in working.

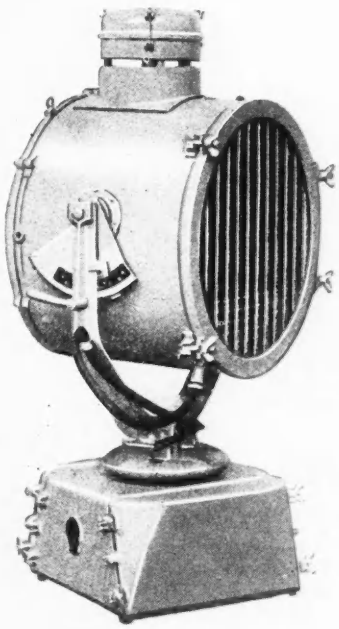
Between 1929 and 1931 the following beacon lines were erected: From Hanover to the Dutch frontier,

in the direction of Amsterdam, distance 112 miles, branching off from it and avoiding the Ruhr industrial area owing to its hilly character and the prevailing bad visibility ; branch line to Cologne and the Belgian frontier in the direction of Brussels, 145 miles ; from Hanover to Fehmarn, in the direction of Copenhagen, 158 miles ; from Berlin to Halle/Leipzig, 90 miles.

The intermediate beacons on the line from Berlin to Hanover were extinguished, and on the line from Berlin to Königsberg only the Neon intermediate beacons which are very cheap to work are still in use. The total length of the lighted airways is 1,085 miles and is illuminated by 97 principal airway beacons and 38 intermediate beacons.

The aim was to bring as much as possible of the light produced to the pilot's eye, and to adjust the repetition of the flash so that the pilot has no difficulty in finding the light again. The beacons are installed on iron masts from six to seven feet high. The following types are in use : Rotary reflector lights with a reflector 24½ inches in diameter and with rotary lens lanterns of which the concentric glasses are from 15 to 20½ inches in diameter. All lights have an automatic device for changing the lamps, which are from 1,000 to 1,500 watts. Rotary reflector lights and rotary lens lanterns thus give a light of from 1,500,000 to 2,000,000 Hefner candle power, which represents a candle power of 400,000 Hefner candles for the pilot's eye, and a range of from 30 to 40 miles. The beacons are turned off and on by special automatic switches attached to each beacon.

There are, in all, fourteen ground direction-finding stations for the entire air service, of which those at Berlin, Hanover, Hamburg, Dortmund, Cologne, Erfurt, Stettin and Königsberg are available for night flying. The method employed is that the bearing of the mobile station is taken by the ground stations on the aerodromes. The direction-finding stations are so distributed over Germany that they give favourable angles for position finding for every place in Germany. Experience shows, however, that aircraft ask for direction or course in most cases, and that position is only asked for from time to time for purposes of verification. The difficulties which arose at first owing to the great deviations of the beam at sunset, night and dawn may be said to have been overcome. A practical method of direction-finding has been developed which gives the fixed bearing, if the bearing is taken in the first few seconds after the aircraft transmitter is switched on. No scientific explanation of this has yet been given.



AN AIRWAY BEACON.
One of the new types of high-power lamps now in use for guiding aeroplanes when flying by night.

Emergency landing places, which are about 500 yards in diameter, have also been erected on the night airways every 40 miles. All aerodromes for night flying and all emergency landing fields are provided with ceiling projectors, as it is of great importance for night flying to know the exact measured height of the base of the clouds. The aerodromes used for night flying are all provided with the following equipment to insure safety in starting and landing : An aerodrome beacon which either gives the characteristic of the aerodrome or, what is better, a revolving beacon with an identification light giving the characteristic of the aerodrome ; boundary lights, generally Neon tubes, at intervals of 100 yards ; red lamps on the obstructions ; one or two illuminated wind indicators or T-shaped tubes ; one ceiling projector.

On German aerodromes and emergency landing fields a line of stable lanterns with different coloured glasses is used to indicate the direction in which landings are to be made. This arrangement is both simple and cheap, and has proved thoroughly effective. So far there has been no necessity to make use of flood lighting, which is expensive to instal and run. The use of stable lanterns has not led to any accidents. The aviation weather service for night traffic is based on the same principles and methods as have proved effective for the safety of day traffic. The daylight arrangements are supplemented by the regular measurements of the height of the clouds by means of ceiling projectors, and the measurement of humidity on the aerodromes and emergency landing

places, in order to facilitate the fog forecast, which is of great importance for night flying. A special night staff of meteorologists is maintained.

It is unnecessary to go into details, as the weather and wireless services for aviation have been regulated by international agreement. The many years' work of the International Air Conferences have resulted in the adoption of fundamental lines of co-operation which are embodied in the regulations for international weather service for aviation and the regulations for international wireless service for aviation. I need hardly mention that the safeguarding of night flying is still occupying the attention of experts. During a discussion on the subject of airways lighting, the late Sir Sefton Brancker once remarked : " We don't need any lighting, for we can't see it in bad weather and in good weather we don't need it." There is a good deal of truth in this remark, but I venture to think that it must be taken with a grain of salt. True, we can fly " blind " now, and direction-finding and the compass are good means of navigation.

But it must not be forgotten that the direction-finding service may be interrupted by atmospherics or thunderstorms. It must also not be forgotten that considerably less strain will be put on the nerves of the pilot if he can fly along a lighted airway when the visibility is good, a fact which must not be underestimated in the interests of the crew. For the minimum visibility of about one mile, airway lighting will always retain its importance. An aeroplane is not like a ship, which can slow up or even stop when there is any doubt about the navigating measures to be taken. Unfortunately, an airman must always know what course he has to take, and in case of doubt at once have all facilities in order to avoid making wrong decisions. The reasons which have led, and will still lead, us in Germany always to maintain good lighting of the airways are maximum safety for flight operations and minimum strain on the crew and material.

Methods of Lighting.

It is impossible yet to say whether beacon distances of 15 miles are the last word in wisdom. There are many people, even in Germany, who are in favour of greater distances, for instance, 20 and even 30 miles. But this must be decided on the basis of experience.

There are those who suggest that beacons should be distinguished by their colour, strength and characteristic. We are of the opinion that all airway beacons must be white and have the same characteristic. In theory, it may seem very convenient that airway lighting should serve not only to give the direction or course, but also the position. These are ideas which seem to be derived from the practice adopted in marine and coast lighting, which cannot be adopted in aviation without objection. The aircraft moves at much greater speed, and the pilot's main business is the steering. He can only devote part of his attention, perhaps from 20 to 25 per cent, to observing the lighting. He cannot observe the direction and characteristic of the beacons at leisure, as the naval officer does, for the line of beacons can only give him the direction—if he is not to be asked to do more than he possibly can. Mistakes in determining the characteristic will always have very serious consequences in aviation. The use of coloured glasses in airway beacons has the great disadvantage that it decreases their range.

International Standards.

We have often discussed whether we ought to attach illuminated letters or figures, identification lights or course lights to the beacons, as has been done in the United States. It cannot be denied that these arrangements may have a certain value. So far we have dispensed with all such additional arrangements as they do not change the fundamental idea of the lighting, and their installation does not appear desirable to us until an international agreement has been arrived at on the subject.

The organization of the safeguarding of night air routes is, in my opinion, to be regarded, not from the national, but from the international standpoint. The present night line from London to Berlin, for instance, which is flown in 6½ hours, passes over three or four countries. It cannot possibly increase the safety if the pilot encounters three different systems of lighting during the course of his flight. The air line, and not the State, must be regarded as the unit for which standards must be found.

The International Air Conferences have already laid down these standards for the wireless, and meteorological service for aviation. The International Aviation Lighting Committee has already done valuable pioneer work in the matter of standardizing the technical terms, scientific physical research, and the treatment of questions concerning airway lighting. But practice must be decisive in these matters and utilize experience. It will be easier to arrive at a uniform point of view in this way, for practical airmen are more likely to agree than scientists. The longer the delay in arriving at uniformity, the more difficult will it be to do so, for the question of the cost of changing existing lighting arrangements will always stand in the way.

Book Reviews.

The Map of England. By COLONEL SIR CHARLES CLOSE. (Davies. 6*s.*).

The Ten-Mile Road Map of Great Britain. (Ordnance Survey. 2*s.* 9*d.*).

The Half-Inch District Map of the Cotswolds. (Ordnance Survey. 3*s.*).

The One-Inch District Map of the Chilterns. (Ordnance Survey. 3*s.*).

The One-Inch Map of England and Wales. Fourth Revision. Sheets 137 and 144. (Ordnance Survey. 3*s.*).

Although a distorted preoccupation with the past is a current and accepted characteristic of English books intended for the general reader, no evidence has yet been brought forward to show that it is anything but eccentric and discreditable. Sir Charles Close, as an ex-Director-General of the Ordnance Survey, might be expected to have some caustic remarks to make about the economies by which its work is crippled, or to provide a lively discussion of how far military considerations have influenced the development of the one-inch maps against public convenience, or to have definite ideas as to whether the new fourth revision maps are the success they are made out to be or something in the neighbourhood of a flop. He might be expected to provide stimulating discussions of the future at every turn. What actually happens is that more than half the book is given up to excellent if rather elementary discussions of the remains of prehistoric, Roman, Saxon, Elizabethan, and seventeenth century England, a large part of the remainder to a historical summary of pre-Ordnance maps and of the Ordnance Survey itself, and well under a quarter to considerations that can charitably be called contemporary. If this book were called " English History on the Map " it would be a good book, but when one understands that it is not intended to be historical but merely represents his sense of proportion it becomes a little dispiriting.

The Ten-Mile road map illustrates, though less strikingly, the same conflict of historical and technical preoccupations with the facts as they are. It shows the sizes of towns well, the Ministry of Transport road-numbers excellently, and its inset-maps of developed areas are clear and well-chosen. But it is unwilling to do at all what it cannot do thoroughly, and it is half-hearted at every point whose value is purely empiric. Road-distances are rarely inserted, rivers and mountains are all un-named, heights are unmarked, and such locally important road-junctions as Bettwys-y-Coed are wrongly spelt in microscopic type merely because the places themselves are small. It is a fine road map, but essentially inhuman. Even with quarter-inch maps the Ordnance Survey preserves a pained detachment. Such cheap commercial maps as the three-inch to the mile series marketed by Woolworth's show a better grasp of small-scale problems. But with the half-inch, clarity of detail and technical virtuosity begin to come into their own. The new half-inch of the Cotswolds shows a care in marking the destinations of roads when they leave the map which is altogether new to us. And the end-papers are imaginatively well used to make clear the relation of the map's area to points outside it.

The One-Inch third revision map of the Chilterns, brought up-to-date by marking Whipsnade Zoo and employing the new symbol for National Trust areas, is included here largely for contrast with the fourth revision. The framework of the map is nearly twenty years old. Those twenty years have been, to put it mildly, eventful in their effect on the face of England, as well as on cartographic technique. A new revision was certainly necessary. And there can be no doubt that the fourth revision, whose first two sheets of the Devon and Cornwall borders are now published, represents a clear advance on the English third. The new types, though archaic and offensive, are much more distinctive; the addition of hachures and a suspicion of layer-tinting to the fifty-foot contours, though ugly and regrettable, is saved from being catastrophic by the greater clarity of the detail; and the additional symbols which now indicate National Trust Areas, the Electricity-Grid system, etc., are genuinely useful. The Scottish Third Revision, which managed to get clarity without preciosity into its types, and to make the run of contours startlingly plain simply by thickening the contours at every two hundred and fifty feet, is clearly its superior. But with that exception the new edition, even on its completion in about ten years' time, will probably provide easily the best set of topographical maps in the world. It is this general efficiency that makes the change-over from grid-squares with a two-mile side, enclosing a comprehensible and easily handled area, to a 5,000-yard side enclosing an unmanageable complex of square miles and acres and rods, poles, or perches, and square yards, so disappointing. The system of co-ordinates which is supposed to excuse the change could just as easily have been hinged on to the two-mile square; metrically the size is equally valueless both in linear and square measure; and the only possible arguments in its favour are an unpleasant reminder of the meaning of the word " Ordnance." It seems pretty certain that an ideal unit for scientific as well as walking purposes has been summarily disposed of to facilitate target practice.

Hunted. Through Central Asia. By P. S. NAZÁROFF. Translated by MALCOLM BURR. (Blackwood. 7*s.* 6*d.*).

There are fashions in books as in everything else, but, like the poor, the travel book is always with us. Of recent publications, some have been good, but most have been more conspicuous as " thrillers " than as reliable accounts of scientific observation. We are all familiar with the rather tiresome person who, after a brief sojourn in a foreign land, returns to record his hasty impressions. Reliable books about Russia are rare; and as far as it deals with Russia, M. Nazároff's chronicle is among them. But this is not entirely a book about Russia, although it throws intimate light upon the methods of the Soviets and particularly of the Cheka agents. It is a book about a Russian who was obliged to flee the country and spent two precarious years among the nomad tribes of Turkestan. It would be difficult to find a book which combines so rich a chronicle of personal adventure with so reliable an account of scientific observation. M. Nazároff is a geologist and naturalist of distinction, and few trained scientists have had better opportunities of observing the semi-savage Sarts and Kirghiz, among whom the author lived. His wide scientific knowledge and acute observation make the book a store of knowledge.

Unlike the Kirghiz, " whose houses are open all the time so that anyone who likes may walk in," the Sarts guard their families and their homes jealously: their gates are always locked and no one can go in unasked. The farmhouse in which M. Nazároff was sheltered by a friendly Sart—an enemy of the Russians—was built of clay, while a few pieces of dirty felt lay about the floor, and they, with a couple of boxes against the walls, formed the entire furniture of this miserable home.

"Our host met us in a small courtyard and opened a door leading into a room with a mud floor, feebly illuminated by a *chirak*, a primitive little oil lamp, of the same design of those of Greece and ancient Egypt. Not far from the door, round a glowing fire, there squatted two women, a young man and a boy. They were not in the least embarrassed at my presence, although the Mahommedan law forbids women to show the face to strange men." It has seldom, if ever, fallen to the lot of a European in Turkestan to live in a purely Mahommedan home and observe the intimate life of a Sart family. One evening the author's host announced that he intended to divorce his second wife. The next day at twelve o'clock the *mullah* came. They sat in a circle, and the mullah read a prayer. Then they ate a *palau*, and that finished the ceremony. An hour later the Sart drove his divorced wife with her baby and baggage to Tashkend where she had come from: it was all as simple as dismissing a servant.

The manners and customs of the Sarts hardly encourage tender feelings. Their poetry, as would be expected, is very poor and this matter-of-fact people have no songs. The Kirghiz, on the other hand, are a poetic race. They love music and are fond of improvising. A well-known Russian poet, V. Krestovsky, published some years ago a book of verses under the title "Songs of Spain." These were translated not from the Spanish but from the Kirghiz. Over an immense area in Asia where the wandering Kirghiz have scattered, their manner of life and their peculiar culture is the same. Their manner of life has played an important part in the history of Asia. M. Nazároff suggests that it has reacted on the fate of Russia and that even western Europe has not escaped its influence. "Just as the Normans in their day made use of their mobility upon the seas to spread their influence and culture throughout the west, so these nomads of the steppes of Asia have done the same in the east. The broad belt of grassy plains across the old continent, which has given rise to the peculiar type of nomad Turki and his inseparable comrade, the horse of the steppe, has had enormous influence on the destinies of the settled nations and of civilization itself."

Dr. Burr's translation of the manuscript is sympathetic, and he has faithfully reproduced the author's apt choice of words. The price of the book is lower than is usual for this class of book, and is in keeping with the times.

The Roads of England. By R. M. C. ANDERSON. With a Foreword by Sir WILLIAM R. MORRIS, Bart. (Benn. 8*s.* 6*d.*).

Miss Anderson's short history of our roads is a very sound and attractive piece of work. No other book surveys the whole subject so clearly and accurately from prehistoric times to the present day. The author has read widely and used the latest authorities, and she illustrates her text with sixteen useful sketch-maps. The interest and importance of the theme are apparent, especially now that, unhappily for railway shareholders, we have all returned to the roads.

The author begins with the primitive trackways, which, she thinks, were originally planned as series of straight lines—a theory which Mr. Alfred Watkins has done much to establish. The Romans, in some cases at least, reconstructed these old ways, as part of their wonderful road system. They had no successors till modern times. The Saxons, and the Danes after them, used the Roman roads in their incursions, but did not trouble to keep the roads in repair. In the Middle Ages there was plenty of road traffic, as the late M. Jusserand has shown in his classic treatise on "English Wayfaring Life"; pilgrims and merchants, knights of the shire and lawyers, pedlars and beggars, thronged the roads. But there was no national policy of road maintenance, and travellers went at their peril. Pilgrimages ceased with the Reformation; but the development of trade soon brought new traffic. Still nothing was done, except under the Commonwealth, until in the eighteenth century private syndicates were allowed to take over stretches of road and impose tolls in return for their outlay. Miss Anderson admits the abuses of the turnpikes but justly allows that they were a first step to reform. Then came Wade with his military roads in Scotland, Macadam with his new method of road construction and his sound ideas of road policy, and Telford, who made the Northern Highlands accessible and built the modern Holyhead road. The mail coach and the fast stage coach, of which Mr. John Drinkwater's "Inheritance" gives delightful reminiscences in addition to the books named by Miss Anderson, made road maintenance more urgent. But just when the need was being recognized, the railway age began and left to our own generation the task which is now being fulfilled perhaps with excessive enthusiasm and certainly at an enormous cost. The story thus briefly outlined is admirably told by Miss Anderson. Her book should have many readers.

The Annals of Archaeology. Vol. XIX. Nos. 1 and 2. (University of Liverpool Press. 12*s.*).

The site of Old Jericho, a mound now called Kom el Sultan, was first tentatively explored in 1868. Systematic excavations were undertaken in 1907-9, when a principal feature of the old city was found to be a great stone glacis which entirely circumscribed the foot of the mound, enclosing an area of some twelve acres; while at a higher level, around the brink of its slopes, there was traced another defensive system, comprising apparently two parallel brick walls, the inner about 12 feet thick, the outer half as much, with a contained area of some six acres. At the time, though not without reserve and criticism, the stone glacis was assigned to the second phase of the Iron Age, and was believed to represent the Israelite re-occupation of the site in the tenth century B.C. The brick walls were assigned to an early period in the Bronze Age. In the light of subsequent discoveries in Palestine these conclusions were reconsidered, and in 1926 the stone glacis was assigned to the Middle Bronze Age, and the brick walls to a still earlier date. These results, which agreed closely with the known archaeology of the site, have now received substantial amplification. In the volume under review, Professor John Garstang describes his excavations in 1930-31, carried out for the Institute of Archaeology of the University of Liverpool.

The new excavations have disclosed the existence of two other systems of Bronze Age fortification, the one earlier, the other later, than those previously discovered. The earlier pertains to the Early Bronze Age, before 2000 B.C., and underlies the inner brick wall along the western brink of the mound. The later overlies the same brick wall along the western side, being readily traced where the mound is not denuded; but elsewhere it follows an independent line. The position of ancient Jericho was determined by the copious spring of good water which still gives life to the orange groves and modern village below it to the east. To the immediate west rose the original mound. Excavation of the mound revealed Bronze Age deposits at an early stage, and deposits of an earlier age were brought to light at a lower depth. Four chief phases

during the Bronze Age have been discerned in the archaeology of the site; and these are determined by the changes in the position and character of the city's defences, with corresponding changes in the predominant types of pottery and other culture-products. Professor Garstang's account describes the Early and Middle Bronze Age cities, and is to be continued to include an account of the Late Bronze Age, from 1600 B.C. until the final destruction of the Bronze Age city.

A tomb of the Middle Bronze Age period was located after considerable search between the city mound and the western hills. There are other tombs in the vicinity. A second one immediately adjoins this, and proved to be of Byzantine date; while observations from the air suggest that three or four hundred tombs are to be found in the neighbourhood of the small valley which leads down from this spot towards the north end of the city. This necropolis appears to be intact. The fact that no potsherds are found littered about the surface, while depriving us of the usual indications, encourages further excavation. Professor Garstang writes that the collection of pottery found in the tomb constitutes an archaeological group of the highest interest. "The dating of archaic specimens by theory can now be abandoned. The great variety of forms and technique, the fine finish of some objects, and the crude quality of others, show that the poorer and finer aspects of the ceramic art moved side by side. The wheel was known and employed commonly for finishing the necks, but not always for building up the vessels. The small juglets were commonly made in two halves and imperfectly joined together, though no mark was visible on the outer surface. Some specimens of the period were entirely worked by hand, but the surface was in nearly all cases smoothed before baking." A fuller description will clearly be called for when the exploration of the necropolis has advanced a further stage.

Bees, Wasps and Ants. And Allied Insects of the British Isles. By EDWARD STEP. (Warne. 10*s.* 6*d.*).

Although the natural order of insects, which includes the bees, wasps, ants and their numerous allies embraces the highest examples of insect-evolution, it has received comparatively scant public attention. Mr. Step, indeed, declares that while the average man considers that he can distinguish a bee from a wasp, and either from a fly, he fails to realise that bees are legion; and some insects that he supposes to be bees are really flies; some of the layman's supposed wasps, also, are flies and some are bees! Errors in this direction are largely due to dependance upon a single character—usually that of colour—as a basis of judgment. Many flies and some bees wear a passable imitation of the wasp's livery, with a view to deluding the simple minded among birds, lizards, and other insect eaters; incidentally, but frequently, they impose on man. In the Hymenoptera, with which this latest addition to the "Wayside and Woodland" series deals, the usual four stages of insect development are well marked—egg, larva, pupa and imago. The egg is laid always on or in the food suitable for the nourishment of the larva, and in quantity sufficient to support it through this stage; often provided by astonishing industry on the part of the mother or sisters. In all larvae except that of the sawflies, the waste of the body is retained in the intestine until the last skin is shed.

In the adult stage many of the Hymenoptera differ from most other insects in the fact that they form large social communities in which the interest of the individual is sunk in that of the fellowship. Some of these societies, too, such as those of the humble-bees, the social wasps and the ants, are remarkable for having two forms of female, the queens and the workers. The Hymenoptera that have been described and classified number about seventy thousand species; they have been arranged in many genera which are grouped to form numerous families, which in turn are placed under the two sub-orders into which the order is divided: these are the Symphyta and Apocrita respectively.

In the critical examination of these insects for the identification of species that are very much alike, the expert takes into consideration the character and relative lengths of the joints of the antennae, the neuration of the wings and more particularly the structure of the tongue and other mouth parts, which vary considerably in different genera. To-day, also, many experts insist on the examination of the male genitalia. Mr. Step's book is not intended for those who desire more than a general knowledge of the groups of some of the commoner representative species. In the field anything in the nature of dissection is out of question: and this is a book for the field naturalist.

An interesting feature of the book is the wing maps of the Hymenoptera. We believe this is the first volume in which this method of classification has been fully illustrated. Admirers of this attractive series of books will welcome this useful addition, completed just before the author's death.

The Story of Science. By DAVID DIETZ. (Allen & Unwin. 10*s.* 6*d.*).

The growing popular interest in science which has marked the post-war years has produced any number of books, helping the layman to a better understanding of modern progress in various branches. Mr. Dietz's book is a useful addition to the list. It opens with the "Story of the Universe" which deals with the latest discoveries in astronomy. It discusses modern views of the size, structure and organization of the Universe and the position of the earth in the solar system. Mr. Dietz records what astronomy has found out about the nature of planets, comets, stars and nebulae. The author proceeds next to the "Story of the Earth," and discusses modern theories of the origin and structure of the earth, geological processes and the record of the earth's history. The third part of the book is the "Story of the Atom," a discussion of the molecule, the atom and the electron, the "building blocks" from which the universe is fashioned. New views of energy, and such theories as the quantum theory, wave mechanics and Einstein's theory of relativity are discussed. The fourth part of the book is the "Story of Life," from the microscopic forms to man. Mr. Dietz has compiled a valuable and entertaining summary of modern progress in the subjects which form the various parts of his book. It is well, though not lavishly, illustrated, and there is an index and an appendix consisting of tables of the planets and the first magnitude stars, of the geological eras, the chemical elements, and of ancient man and his probable periods.

Improvement of Woodlands. By W. E. HILEY. (Country Life. 10*s.* 6*d.*).

Mr. Hiley, who was lecturer in Forestry Economics at the Oxford Forestry Institute, has written a thoroughly practical book on the methods by which woods can be made to pay. Too many impoverished landowners, as he says, fear to spend money

on their woodlands. Costs are high and prices low and uncertain. Yet Mr. Hiley maintains that scientific forestry in England was never more certain than now to yield a reasonable profit, and he gives good reasons for a somewhat surprising assertion by enumerating the abatements of income-tax on woodlands and the loans made by the Forestry Commission. An owner can, he declares, " create plantations worth £10 per acre for £1 10s., and the investment is so attractive that no one can afford to miss it." But the planting must be of the right kind, and the author discusses this matter in detail. Moreover, plantations need careful management. The difficulty that arises with many small estates, whose owners cannot afford to employ experts, might, the author thinks, be overcome by co-operation. But this, in England, is always hard to arrange, unless the parties are exceptionally friendly and good tempered.

It is often said that forestry and game preserving are incompatible. However, Mr. Orde-Powlett, in an enthusiastic and sensible chapter on " How to Combine Sport with Forestry " maintains that paying plantations may be combined with good pheasant coverts, and his argument at least deserves attention. Finally, Mr. Hiley attacks the controversial problem of amenities, which has recently been raised in connection with Magdalen College's felling of the famous grove at Gilbert White's Selborne. " Some amenity woods are becoming so old that the individual trees are fast falling into decay and, unless they have some historic interest, only a perverse sentimentalism will demand their retention." In these words Mr. Hiley summarises the situation at Selborne, though he does not refer to it directly. It is a pity that trees are not immortal.

Touring the Ancient World with a Camera. By C. G. Holme and W. Gaunt. (The Studio. 7*s.* 6*d.*).

This is far more than a pictorial guide-book for the tourist. The authors embarked at Genoa, sailed down the coast of Italy, called at Sicily, passed through the Carinth Canal, breaking their journey at Athens. Thence the route lay by boat to Istambul, whence they returned through the Dardanelles, along the coast of Asia Minor, paying a visit to the Island of Rhodes and making an excursion into Syria. From Jerusalem they made for Cairo, across the Suez Canal, then along the Nile to Assouan, and so to Alexandria. Mr. Holme's photographs, of which there are about 150, are masterly, and Mr. Gaunt's brief explanatory notes are adequate but not effusive and have none of the conventional guide-book's fatuities. The pictures tell the story, and the notes record the traveller's impressions rather than attempt a detailed explanation of the photographs. The only suggestion we have to make is that one of Mr. Holme's photographs would have made a much more attractive cover design than Mr. Tom Purvis' scrappy diagram.

Readings from Modern Science. Edited by W. J. Bransom. (Harrap. 3*s.* 6*d.*).

The publishers are to be commended on the happy idea of selecting chapters from the works of leading scientists and publishing the collection at a modest price; and the editor has shown discrimination in the choice of authors who possess both scientific knowledge and the gift of expounding it lucidly. Within the compass of 250 pages it is clearly impossible to present more than some glimpses of recent scientific enquiry. To traverse the whole field of natural science would be an impossible task. " Some authorities," writes Mr. Bransom in an introduction, " have expressed the belief that we have come to a pause in physical science, and that the most fruitful field of discovery now lies in those branches of scientific work concerned with living things. In the light of extended knowledge the mechanistic view of the universe that once prevailed has begun to fade. Sir Arthur Eddington reminds us of the co-existence of two worlds. One is the world of our common experience of material things, things we take very much for granted, and to which our senses respond. The other is the world of the physicist, to whom ' gross matter ' presents a very different aspect. It is a world of ' shadows not substantial things.' "

The world of common experience, and the world of " shadows " are represented in this collection. The authors include Sir Arthur Thomson, on " The Immensity of the Universe," Sir James Jeans, on " The Origin of the Solar System," Sir Oliver Lodge, on " The Instellar Ether," Mr. Bertrand Russell, on " Electrons and Nuclei," Professor T. H. Huxley, on " Life and Time," Dr. F. O. Bower, on " Plant Population," Lord Avebury, on " Bees and Wasps," Sir Richard Gregory, on " The Conquest of Disease," and other eminent scientists, past and present. The book is scantily illustrated, but the production is neat.

In Bolshevik Siberia. By Malcolm Burr. (Witherby. 10*s.* 6*d.*).

Dr. Burr took the opportunity offered by an unexpected visit to Siberia to see as much of the country as he could; politics and economics, " the dull twins that are poisoning mankind to-day," did not concern him. He was interested only in mixing on as intimate terms as possible with the people, and of observing their ways of life. The natives of Siberia offer an interesting field for study. Prominent among them are the Yakuts, whom one regards as Indians. They are, the author says, one of the few indigenous folk who can stand up to civilization. They are ambitious and determined to acquire culture; and they have a definite national consciousness. In the industrial district of Bodaibo there is a population of some twenty thousand. The Soviet authorities hold a rigid control, but not more than ten per cent of the workmen appear to be communists. In the winter, when the Yakuts and some settlers come in to the town, the proportion is hardly more than five per cent.

Dr. Burr has written a most absorbing book. It should be read by all who desire a better understanding of the " land of ice and exile."

The Bible, the Scholar and the Spade. By C. H. Irwin. (Religious Tract Society. 7*s.* 6*d.*).

The object of this book is to describe for the general reader the results of modern excavations and discoveries in lands associated with the Bible. These have greatly increased in recent years and might, the author suggests, be much more fruitful if organizations like the Palestine Exploration Fund and the Egypt Exploration Society received larger support from the public. Dr. Irwin has selected incidents from the Old and New Testaments and endeavours to show how these narratives have been corroborated by the independent evidence of the monuments and papyri. The book is well produced and many interesting illustrations add to the value of the text.

er, 1932

an intro-
ome to a
l field of
concerned
ledge the
has begun
existence
erience of
d, and to
d of the
different
gs.' "
hadows "
clude Sir
erse," Sir
Sir Oliver
ussell, on
on " Life
n," Lord
gory, on
ists, past
roduction

Witherby.

cted visit
politics
mankind
only in
ople, and
eria offer
n are the
e author
o to civi-
culture ;
In the
of some
l control,
ear to be
e settlers
than five

hould be
" land of

. Irwin.

al reader
in lands
reased in
uch more
on Fund
support
from the
ow these
evidence
uced and
text.